Environment Canada
Water Resources Branch
Saskatchewan District

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WATER RESOURCES BRANCH

SASKATCHEWAN DISTRICT

FLOOD OF SEPTEMBER 1986 IN THE WATERSHEDS OF LODGE, BATTLE AND LYONS CREEKS SOUTHWEST SASKATCHEWAN

FLOOD OF SEPTEMBER 1986
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LODGE, BATTLE AND LYONS CREEKS
SOUTHWEST SASKATCHEWAN

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ABSTRACT

In September, 1986 a strong storm system developed over Montana, generating high winds and heavy rainfall. The storm event moved cyclonically in a northwest direction and entered southern Saskatchewan on September 24.

Culminating from a combination of factors, including former hurricane Newton and former tropical storm Madeline, the storm deposited unusually high amounts of rain during the 48 hour period of September 24-26. The resulting extreme flows in the Milk River tributary drainage basins of Lodge, Battle and Lyons creeks caused little structural damage in the area, but did cause considerable flooding and occasional road washout.

Frequency analysis on September rainfall, for climatological stations in the area, yielded storm return periods ranging from 1 in 173 years to 1 in 4 800 years. Meteorological analysis in this report details storm formation and movement.

Data from sixteen hydrometric stations in the immediate area have been analyzed. Included in the analysis are hydrographs showing peak flows for the period of record and for the flood event. The time of occurrence of peak flows at stations in the area shows that the storm moved up the drainage basins, and that peak flows were mainly due to localized precipitation rather than flow from the upper reaches. The maximum instantaneous recorded flow in the region was 280 m^3/s at station Lodge Creek below McRae Creek at International Boundary (11AB083), on September 25.

Frequency analysis has been conducted on those stations for which streamflow regulation is negligible. As September flows in the area range from very small to nonexistent, frequency analysis was conducted using the annual maximum instantaneous flow. Past annual peaks in the area are, however, almost solely the result of meltwater runoff in the spring. The resulting return periods obtained during the analysis, therefore, give the likelihood of a similar event occurring at any time of the year, and do not reflect the likelihood of another rainstorm induced event occurring in September.

ACKNOWLEDGEMENTS

Meteorological analysis was aided and edited by R. Hopkinson, Atmospheric Environment Service, Regina, Saskatchewan. Satellite imagery was provided by T. Thompson, Meteorology Division, Department of Geography, University of Alberta.

TABLE OF CONTENTS

		PAGE
ABSTRACT		i
ACKNOWLEDGEMENTS		ii
1.	INTRODUCTION	5
2.	FLOOD DAMAGES	6
3.	METEOROLOGICAL ANALYSIS	9
	3.1. DATA COLLECTION	9
	3.2. ANALYSIS	9
4.	HYDROMETRIC ANALYSIS	16
	4.1. STATION DESCRIPTIONS	16
	4.2. DISCHARGES	16
	4.2.1. Historical Peak Discharges	16
	4.2.2. Daily Discharges	17
	4.2.3. Hourly Instantaneous Discharge	17
	4.2.4. Flood Peak Discharges	17
	4.2.4.1. Lodge Creek below McRae Creek at International Boundary (11AB083)	18
	4.2.4.2. Battle Creek at International Boundary (11AB027)	27
	4.2.5. Natural Flow	28
	4.3. FREQUENCY ANALYSIS	29
	4.3.1. Battle Creek at Alberta Boundary (11AB117)	32
	4.3.2. Battle Creek below Wilson's Weir (11AB118)	32
	4.3.3. Battle Creek at International Boundary (11AB027)	34
	4.3.4. Middle Creek near Saskatchewan Boundary (11AB009)	37
	4.3.5. Lodge Creek near Alberta Boundary (11AB082)	38
	4.3.6. Lyons Creek at International Boundary (11AB075)	38
5.	CONCLUSIONS	39
6.	REFERENCES	40

Page

APPENDIX A: RAINFALL DATA

Daily Precipitation Records - A.E.S Climatological Stations . . A1
Precipitation Mass Curves
- Medicine Lodge A9
- Altawan (Reservoir) A9

APPENDIX B: HYDROMETRIC STATION DATA

11AB009 Middle Creek near the Saskatchewan Boundary B1
- Station Description B1
- Discharge Hydrographs
  - Historical Peaks B1
  - Daily B2
- Daily Discharge Table, 1986 . . . . . B3
- Flood Frequency Analysis B4

11AB001 Middle Creek below Middle Creek Reservoir B6
- Station Description B6
- Discharge Hydrographs
  - Historical Peaks B6
  - Daily B7
- Natural Flow Estimation, September, 1986 . . . . . B8
- Daily Discharge Table, 1986 . . . . . B9

11AB108 Middle Creek near Govenlock B10
- Station Description B10
- Discharge Hydrographs
  - Historical Peaks B10
  - Daily B11
  - Hourly Instantaneous B11
- Daily Discharge Table 1986 . . . . . B12
- Hourly Instantaneous Discharge Table B13

11AB008 Middle Creek above Lodge Creek B14
- Station Description B14
- Discharge Hydrographs
  - Historical Peaks B14
  - Daily B15
  - Hourly Instantaneous B15
- Daily Discharge Table 1986 . . . . . B16
- Hourly Instantaneous Discharge Table B17

Page

11AB082 Lodge Creek near Alberta Boundary B18
- Station Description B18
- Discharge Hydrographs
  - Historical Peaks B18
  - Daily B19
  - Hourly Instantaneous B19
- Daily Discharge Table, 1986 . . . . . B20
- Hourly Instantaneous Discharge Table B21
- Flood Frequency Analysis B22

11AB103 Squaw Coulee near Willow Creek B24
- Station Description B24
- Discharge Hydrographs
  - Historical Peaks B24
  - Daily B25
- Daily Discharge Table, 1986 . . . . . B26

11AB083 Lodge Creek below McRae Creek at International Boundary . B27
- Station Description B27
- Discharge Hydrographs
  - Historical Peaks B27
  - Daily B28
  - Hourly Instantaneous B28
- Daily Discharge Table, 1986 . . . . . B29
- Hourly Instantaneous Discharge Table B30

11AB117 Battle Creek at the Alberta Boundary B31
- Station Description B31
- Discharge Hydrographs
  - Historical Peaks B31
  - Daily B32
  - Hourly Instantaneous B32
- Natural Flow Estimation, September, 1986 . . . . . B33
- Daily Discharge Table, 1986 . . . . . B34
- Hourly Instantaneous Discharge Table B35
- Flood Frequency Analysis B36

11AB078 Cypress Lake West Inflow Canal B38
- Station Description B38
- Discharge Hydrographs
  - Historical Peaks B38
  - Daily B39
- Daily Discharge Table, 1986 . . . . . B40

11AB118 Battle Creek below Wilson's Weir B41
- Station Description B41
- Discharge Hydrographs
  - Historical Peaks B41
  - Daily / Estimated Natural B42
  - Hourly Instantaneous B42

Page

- Natural Flow Estimation, September, 1986 . . . . . B43
- Daily Discharge Table, 1986 . . . . . B45
- Hourly Instantaneous Discharge Table B46
- Flood Frequency Analysis B47

11AB077 Cypress Lake West Outflow Canal B49
- Station Description B49
- Discharge Hydrographs
  - Historical Peaks B49
  - Daily B50
  - Hourly Instantaneous B50
- Daily Discharge Table, 1986 . . . . . B51
- Hourly Instantaneous Discharge Table B52

11AB096 Battle Creek below Consul B53
- Station Description B53
- Discharge Hydrographs
  - Historical Peaks B53
  - Daily / Estimated Natural B54
  - Hourly Instantaneous B54
- Natural Flow Estimation, September, 1986 . . . . . B55
- Daily Discharge Table, 1986 . . . . . B56
- Hourly Instantaneous Discharge Table B57

11AB018 Nashlyn Canal near Consul B58
- Station Description B58
- Discharge Hydrographs
  - Historical Peaks B58
  - Daily B59
  - Hourly Instantaneous B59
- Daily Discharge Table, 1986 . . . . . B60
- Hourly Instantaneous Discharge Table B61

11AB101 Battle Creek below Nashlyn Project B62
- Station Description B62
- Discharge Hydrographs
  - Historical Peaks B62
  - Daily / Estimated Natural B63
  - Hourly Instantaneous B63
- Natural Flow Estimation, September, 1986 . . . . . B64
- Daily Discharge Table B65
- Hourly Instantaneous Table B66

11AB027 Battle Creek at the International Boundary B67
- Station Description B67
- Discharge Hydrographs
  - Historical Peaks B67
  - Daily / Estimated Natural B68
  - Hourly Instantaneous B68

Page

- Natural Flow Estimation, September, 1986 . . . . . B69
- Daily Discharge Table, 1986 . . . . . B70
- Hourly Instantaneous Discharge Table B71
- Flood Frequency Analysis B72

11AB075 Lyons Creek at International Boundary B74
- Station Description B74
- Discharge Hydrographs
  - Historical Peaks B74
  - Daily B75
  - Hourly Instantaneous B75
- Daily Discharge Table, 1986 . . . . . B76
- Hourly Instantaneous Discharge Table B77
- Flood Frequency Analysis B78

LIST OF TABLES

Page

TABLE 3.1 Return Period of 24 hour Storms..... 11

TABLE 4.1a Summary of Daily Discharges - Battle Creek Basin..... 21

TABLE 4.1b Summary of Daily Discharges - Lodge/Lyons Creek Basins..... 22

TABLE 4.2 Summary of Peak Flows..... 24

TABLE 4.3 Summary of Natural Discharge Estimations..... 28

TABLE 4.4 Estimation of Natural Maximum Instantaneous Discharge at Battle Creek below Wilson's Weir (11AB118)..... 34

LIST OF FIGURES

FIGURE 1.1 Study Location Map..... 2

FIGURE 3.1 500 mb Initial Height Analysis, 18:00 CST September 22..... 11

FIGURE 3.2 500 mb Height and Vorticity Initial Analysis, 06:00 CST September 24..... 12

FIGURE 3.3 500 mb Height and Vorticity Initial Analysis, 18:00 September 24..... 12

FIGURE 3.4 Satellite Photos a) 20:30 CST Septembe: 24..... 13
b) 16:00 CST September 25..... 13

FIGURE 3.5 500 mb Height and Vorticity Initial Analysis, 06:00 CST September 24..... 13

FIGURE 3.6 Sea Level Pressure Initial Analysis, 18:00 CST September 24. 14

FIGURE 3.7 Sea Level Pressure Initial Analysis, 06:00 CST September 25. 14

FIGURE 3.8 Rainfall Isohyetal Curves..... 15

FIGURE 3.9 Climatological Station Locations..... 16

FIGURE 3.10 Cumulative Rainfall Data - Study Area..... 17

FIGURE 3.11 September Precipitation - Comparison of 1986 to September Normals and Previous Maximums..... 18

FIGURE 4.1 Comparison of Peak Flows - Historical & September 1986..... 25

FIGURE 4.2 Altawan Reservoir, Water Elevations..... 26

LIST OF FIGURES

Page

FIGURE 4.3 Schematic Map - Lodge Creek Basin..... 29

FIGURE 4.4 Schematic Map - Battle Creek Basin..... 30

FIGURE 4.5 Station Locations - Cypress Lake West Diversion Canals..... 32

FIGURE 4.6 Regression Analysis - Maximum Daily and Maximum Instantaneous Flows, Battle Creek above Cypress Lake West Inflow Canal (11AB076)..... 36

LIST OF PHOTOGRAPHS

Photograph 1: Lodge Creek near Alberta Boundary (11AB082) September 26, 1986..... 4

Photograph 2: Lodge Creek near Alberta Boundary (11AB082) Channel bank erosion, September 26, 1986..... 4

Photograph 3: Lodge Creek below McRae Creek at International Boundary (11AB083), September26, 1986..... 5

Photograph 4: Middle Creek above Lodge Creek (11AB008) September, 1986..... 5

Photograph 5: Altawan Reservoir near Govenlock (11AB089), Main Spillway, September 26, 1986..... 6

Photograph 6: Altawan Reservoir near Govenlock (11AB089) Emergency Grass Spillway, September 26, 1986..... 6

Photograph 7: Battle Creek below Nashlyn Project (11AB101) September 27, 1986..... 7

Photograph 8: Battle Creek below Nashlyn Project (11AB101) High water levels marked on stage recorder, September 27, 1986..... 7

Photograph 9: Battle Creek at International Boundary (11AB027) September 26, 1986..... 8

Photograph 10: Battle Creek at International Boundary (11AB027) September 27, 1986..... 8

1. INTRODUCTION

This report documents and analyses the causes and effects of the September, 1986 storm which occurred in the Milk River tributary basins of Lodge, Battle and Lyons creeks, in southwestern Saskatchewan (Figure 1.1).

One of the initial aims of this report was to conduct frequency analyses on flows recorded during the storm. Although this was done it was found that due to streamflow regulation in the area many of the resulting flood magnitudes and corresponding return periods were invalid. For proper frequency analysis each peak used in the analysis should be naturalized. This, in itself, would be a major undertaking and beyond the scope of this report. Within this report frequency analysis has only been included for those stations which are negligibly affected by streamflow regulation.

Chapter 2 gives a brief description of flood damage which did occur, along with photographs of several hydrometric stations taken during the flood event. Due to the sparse population in the region, flood damage was minimal and no significant damage to domestic or ancillary structures was reported.

Chapter 3 is a meteorological analysis of the storm. Detailed are storm movement and causal factors in storm formation, including the effects of former hurricane Newton and former tropical storm Madeline. Beginning in Saskatchewan at 21:00 CST September 24 up to 175 mm of rain fell in the 48 hour period of September 24-26, with up to 100 mm falling in the first 16 hours. Total September precipitation for the area ranged from three to ten times normal precipitation amounts.

Chapter 4 deals with the hydrometric analysis of the Milk River tributary watersheds of Lodge, Battle and Lyons creeks. The flows of greatest magnitude occurred at stations Lodge Creek below McRae Creek at International Boundary (11AB083) and Battle Creek at International Boundary (11AB027), where maximum instantaneous flows of 280 m^3/s and 277 m^3/s, respectively, were recorded. Sixteen hydrometric stations in the study area have been analyzed. Included in the analysis are station descriptions and discharge hydrographs. The hydrographs show maximum instantaneous and maximum daily flows for the period of record as well as daily and hourly instantaneous flows for the flood period. Hourly hydrographs are not available for all stations. For the month of September, 1986 flows were naturalized for stations where possible, and natural flows are shown on the daily hydrographs. Hydrograph data are presented in both tabular and graphical format.

STUDY LOCATION MAP

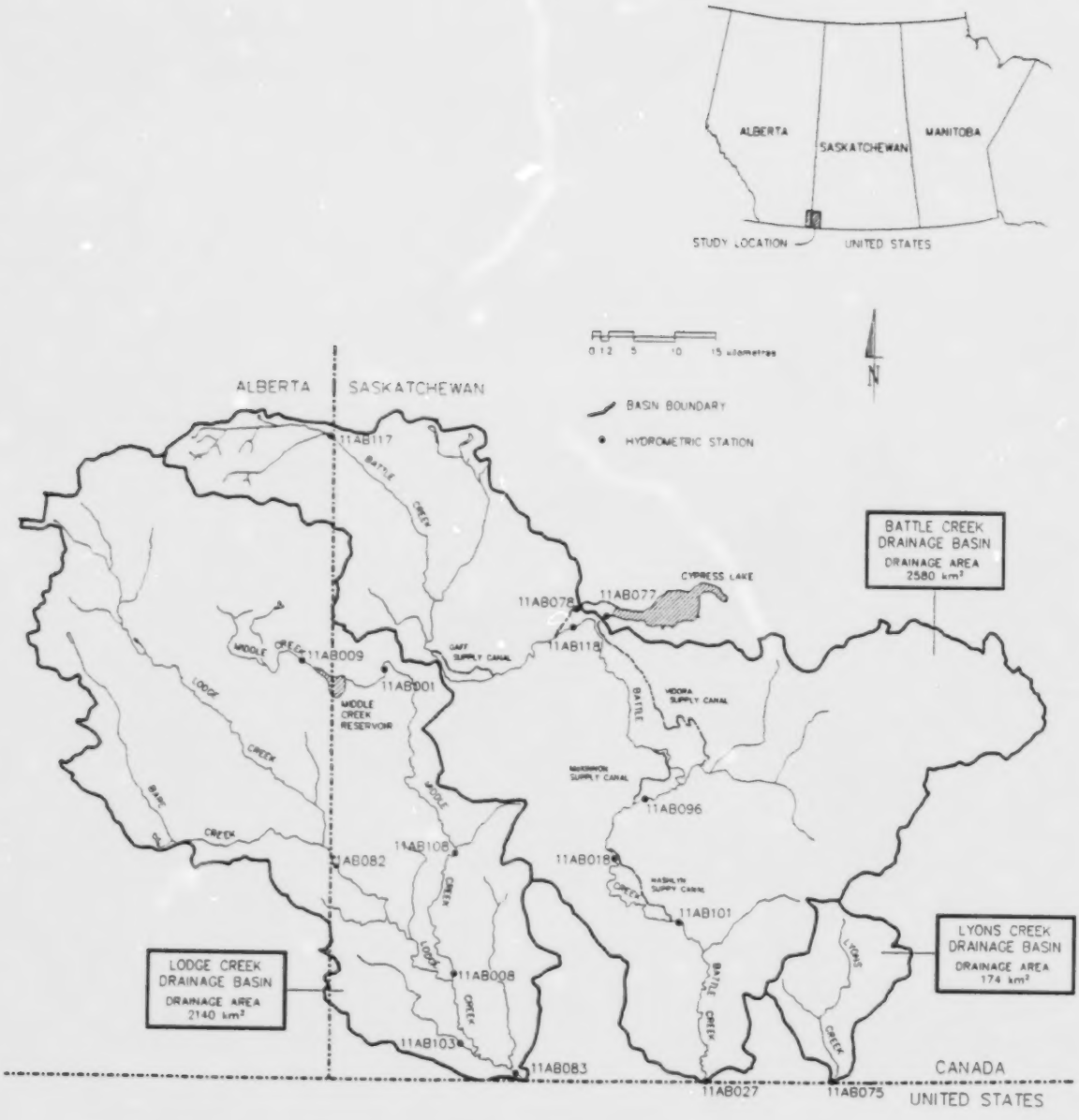


FIGURE 1.1

2. FLOOD DAMAGES

The area of study in southwestern Saskatchewan is a sparsely populated region consisting predominantly of community pasture and dry land farming. As a result no communities were significantly affected by the flood and damage was restricted to road washouts, washout of a bridge abutment at Squaw Coulee on Highway 21, and the partial submergence of several hydrometric stations.

Photographs showing the flood area follow. Open arrows are used to indicate station and cableway locations and closed arrows to indicate flow direction.

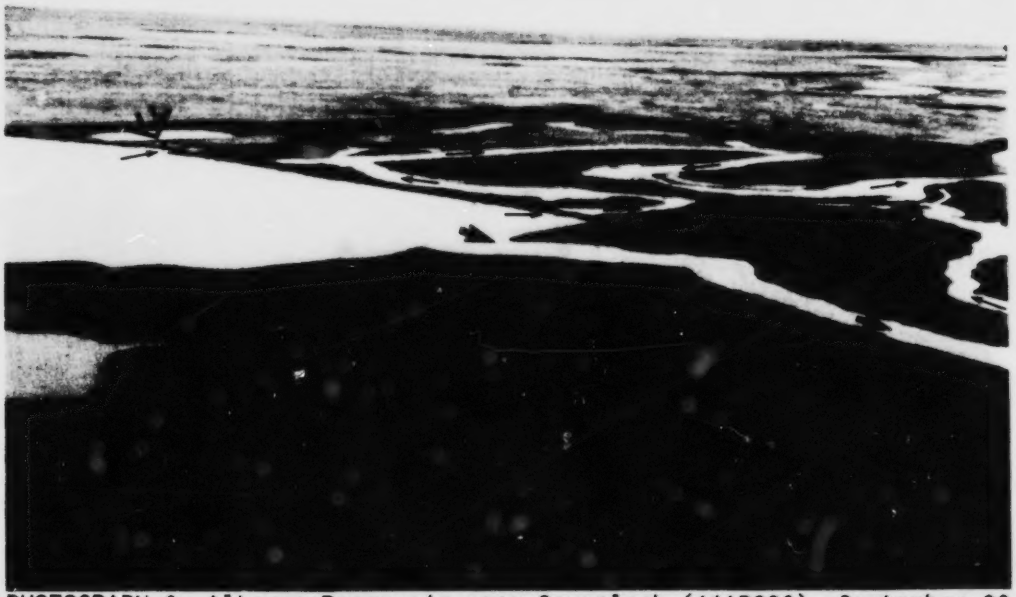
PHOTOGRAPH 1: Lodge Creek near Alberta Boundary (11AB082), September 26. Stage approximately 1 m below peak, Q=116 m^3/s. Peak Q=177 m^3/s.

PHOTOGRAPH 2: Lodge Creek near Alberta Boundary (11AB082), October 8. View shows channel erosion on the right bank.

PHOTOGRAPH 3: Lodge Creek below McRae Creek at International Boundary (11AB083), September 26. Flow is at near peak levels. Peak Q=280 m^3/s.

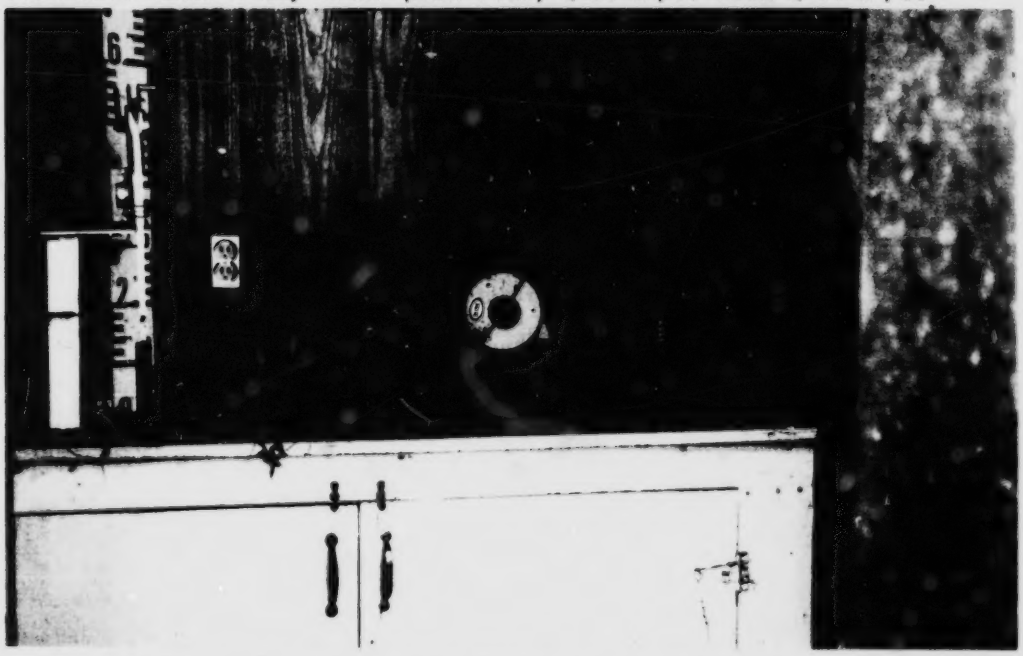
PHOTOGRAPH 4: Middle Creek above Lodge Creek (11AB008), September 26. View shows backwater effects of Lodge Creek near peak flow.

PHOTOGRAPH 5: Altawan Reservoir near Govenlock (11AB089), September 26. View shows main spillway. Water elevation is approximately 1 m above FSL.



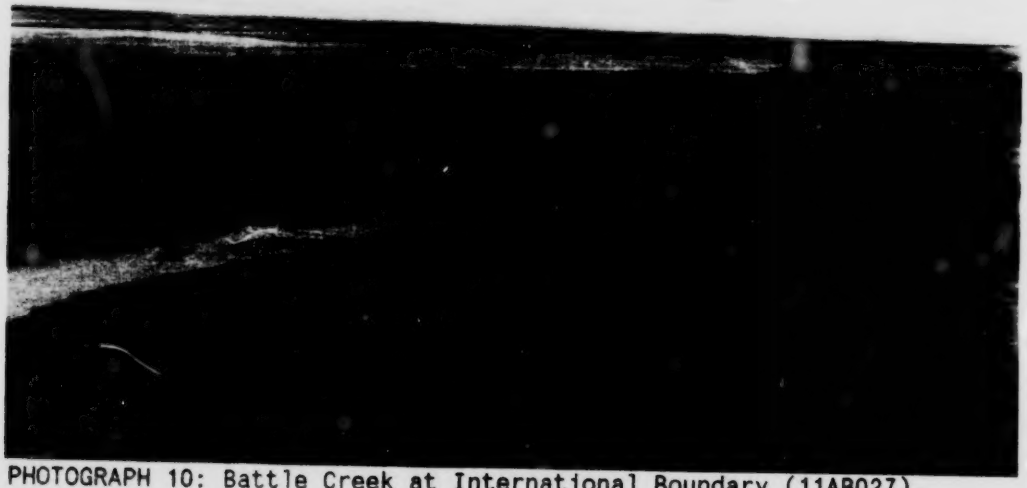
PHOTOGRAPH 6: Altawan Reservoir near Govenlock (11AB089), September 26. View shows emergency grass spillway exiting to the right. Main spillway can be seen in upper left of photo.

PHOTOGRAPH 7: Battle Creek below Nashlyn Project (11AB101), September 27. Photo taken 1 day after peak flow, Q≈28 m^3/s. Peak Q≈41 m^3/s.



PHOTOGRAPH 8: Battle Creek below Nashlyn Project (11AB101), September 27. The arrow indicates the high water mark inside the station.

PHOTOGRAPH 9: Battle Creek at International Boundary (11AB027), September 26. Stage is 1.1 m below peak with Q=64 m^3/s. Peak Q=277 m^3/s.



PHOTOGRAPH 10: Battle Creek at International Boundary (11AB027), September 26.

3. METEOROLOGICAL ANALYSIS

A very intense storm formed over Wyoming late on September 24, 1986 and moved into Montana early on September 25, where it reached its maximum intensity. As the system began to weaken it moved cyclonically to the northwest, across southwestern Saskatchewan and into southern Alberta.

The storm was the result of strong dynamics and an abundance of low level moisture. A strong upper trough developed along the west coast of the United States, and, simultaneously, the remains of hurricane Newton moved from the Gulf of California across central Texas into the midwestern United States. Moisture from former tropical storm Madeline was entrained into the southwestern United States. A second vigorous upper trough dug southward from the Gulf of Alaska and forced the leading trough on the California coast northeastward, resulting in strong winds and heavy rainfall in Montana.

Even though storm intensity was weakening as the system entered southwestern Saskatchewan, precipitation along the leading edge of the storm exceeded all previously recorded extremes. Falling on soils wetted from previous September 1986 rains, the storm event caused record breaking flows in the Lodge, Battle and Lyons Creek drainage basins.

3.1. DATA COLLECTION

Information was obtained from the National Weather Service Forecast Office, Great Falls, Montana, and the National Weather Service Office, Western Regional Headquarters, Salt Lake City, Utah. Satellite photographs of the event were obtained from the Meteorology Division, University of Alberta. Precipitation and temperature data were collected by Atmospheric Environment Service (AES) from a number of sources. Data from climatological stations in southwestern Saskatchewan and southeastern Alberta were combined with data from a tipping-bucket rain gauge (operated by Environment Canada, Water Resources Branch) at Altawan, a weigh-type rain gauge (operated by Alberta Environment) at Medicine Lodge, and values from rain gauges used by area residents.

3.2. ANALYSIS

During the week of September 22 an unseasonably strong upper level trough developed over western North America. A strong upper trough from the Gulf of Alaska moved southeast and an upper low formed over the California coast (Figure 3.1). By 18:00 CST September 23 moisture in the remnants of tropical storm Madeline had moved northeast, from the Pacific Ocean off the California coast, and was located primarily in Arizona and Utah. Former hurricane Newton had moved north across central Texas from the Gulf of California and moisture extended from Texas to Nebraska. From 18:00 CST September 23 to 06:00 CST September 24 this upper level low accelerated eastward to

western Arizona in response to the digging short-wave trough moving southeast from the Gulf of Alaska. This can be seen with the valid forecasts obtained using the Limited-area Fine Mesh (LFM) model, Figure 3.2. By 18:00 CST September 24 the open trough remains of the original upper low were in southeast Wyoming (Figure 3.3). Satellite imagery (Figure 3.4a) shows the storm pattern developing over southwestern Saskatchewan. By 06:00 CST September 25 the vorticity centre had intensified and moved to eastern Montana (Figure 3.5), where it reached its maximum intensity. By 16:00 CST September 25 the centre had moved northward into Saskatchewan (Figure 3.4b). On the surface, a closed 986 mb low formed in eastern Wyoming by 18:00 CST September 24 (Figure 3.6). During the 12 hour period from 18:00 CST September 24 to 06:00 CST September 25 this low moved north and intensified to 974 mb (Figure 3.7). Sustained surface winds of 50 to 80 km/h were recorded at this time, with gusts reaching 110 km/h. An inverted trough extended to the northwest from the surface low centre, parallel to the heavy rain axis. It was during this period that the heaviest rains occurred in southwestern Saskatchewan.

The axis of major precipitation, as seen on the isohyetal map (Figure 3.8), ran parallel to the path of storm movement and extended approximately 250 km from the Missouri River in Montana to Altawan in southwestern Saskatchewan. Cumulative precipitation during the 48 hour period of September 24-26 reached 175 mm. The minimum recorded temperature, measured the day before the storm on September 23 at Altawan, was 4.0°C. In Saskatchewan snow was recorded only in the Cypress Hills, where 2.5 cm fell on September 25.

Climatological station locations and precipitation amounts are shown in Figure 3.9, and monthly records, as monitored by Atmospheric Environment Service for the month of September, are given in Appendix A. The mass curves presented in Figure 3.10, depicting cumulative precipitation for six climatological stations, show that precipitation in the study area for September prior to the main event ranged from 50 mm to 90 mm. Comparisons of September 1986 precipitation to normal precipitation values are given in Figure 3.11. At these six climatological stations the September 1986 precipitation was 342% to 960% higher than normal precipitation (1951-1980), with a mean increase of 688% over the normal. Mass curves for Medicine Lodge, Alberta and Altawan Reservoir, Saskatchewan (Appendix A) for the period 21:00 CST September 24 to 21:00 CST September 26 show that the greater portion of rain fell in the first 12 hours.

The 24 hour probable maximum precipitation (PMP), as determined by AES, for the area is 250 mm to 300 mm. Prorated for a September rainfall the PMP is 138 mm to 165 mm. The largest precipitation in 24 hours, of 106 mm recorded at Willow Creek,

was not far below the PMP. Table 3.1 compares the September 1986 24-hour rainfall values with previously recorded extremes, and gives the calculated return periods for five climatological stations in the area. When compared and analyzed with annual extremes the event was found to have a return period ranging from once every 16 years to once every 336 years. When analyzed for a September event the return period ranged from one in 173 years to one in 4 800 years.

TABLE 3.1

STATION	YEARS of RECORD	RECORDED 24 HR MAX.(mm) SUMMER	SEPT.	STORM EVENT 24 HR (mm)	RETURN PERIOD (yr) ANNUAL	SEPT.
Altawan	18	95.3	53.3	99	58	212
Willow Creek	48	96.5	79.5	106	336	2500
Consul	34	86.6	38.1	91	310	4800
Medicine Hat	104	121.9	118.6	96.6	65	460
Manyberries	60	78.9	50.1	62.5	16	173

Hopkinson, R., 1989. Atmospheric Environment Service

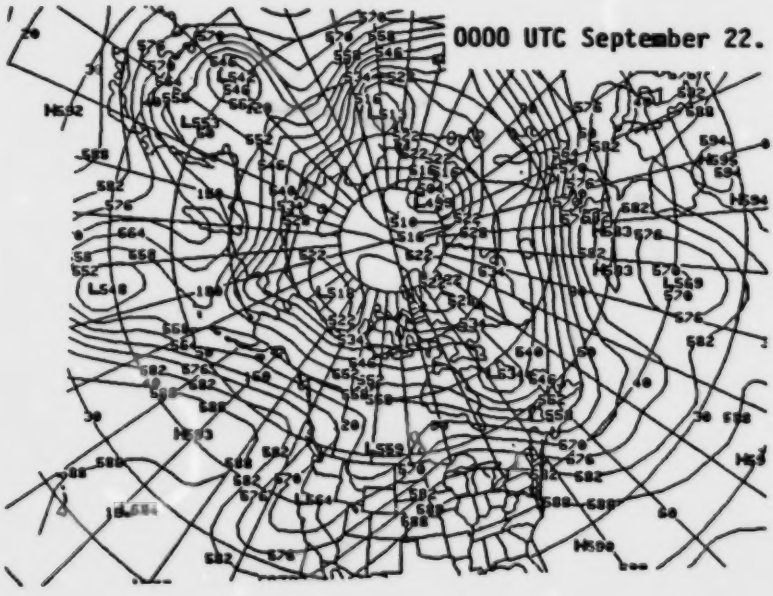


FIGURE 3.1 500 mb hemispheric initial height analysis. 18:00 CST September 22

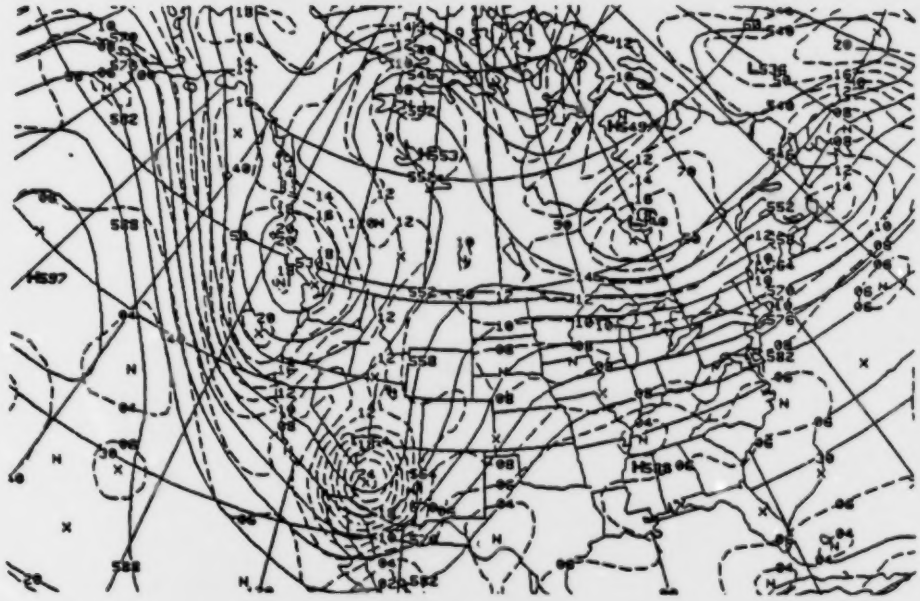


FIGURE 3.2 LFM 500 mb height and vorticity initial analysis.
06:00 CST September 24

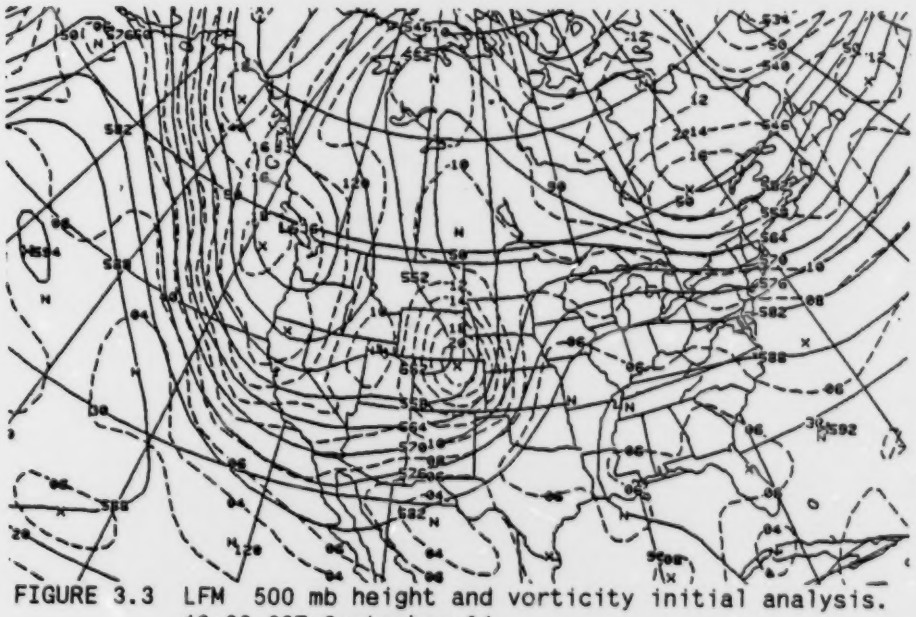
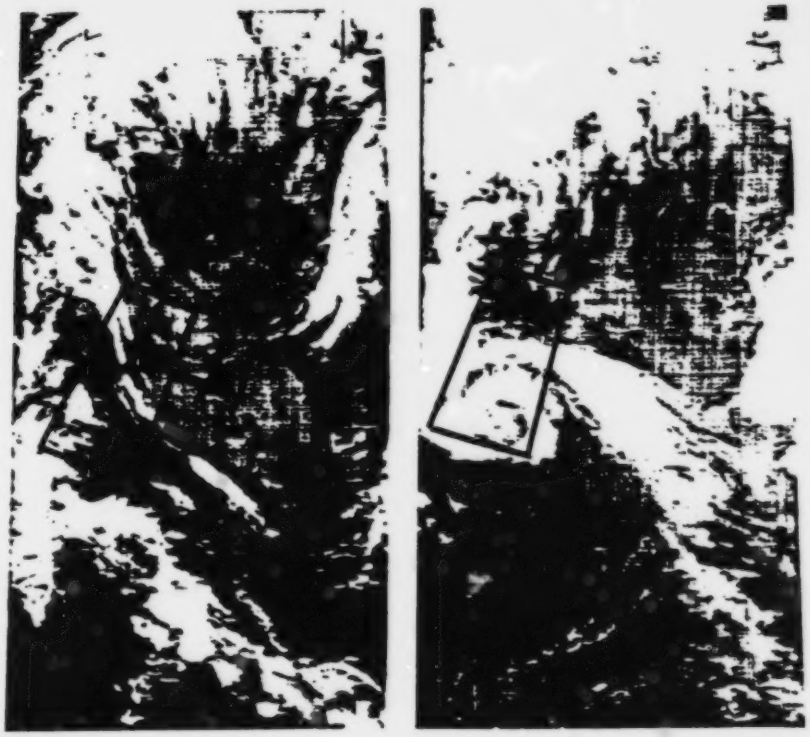


FIGURE 3.3 LFM 500 mb height and vorticity initial analysis.
18:00 CST September 24

FIGURE 3.4

SATELLITE PHOTOS
a) 20:30 CST
Sept. 24, 1986

b) 16:00 CST
Sept. 25, 1986



(a) (b)

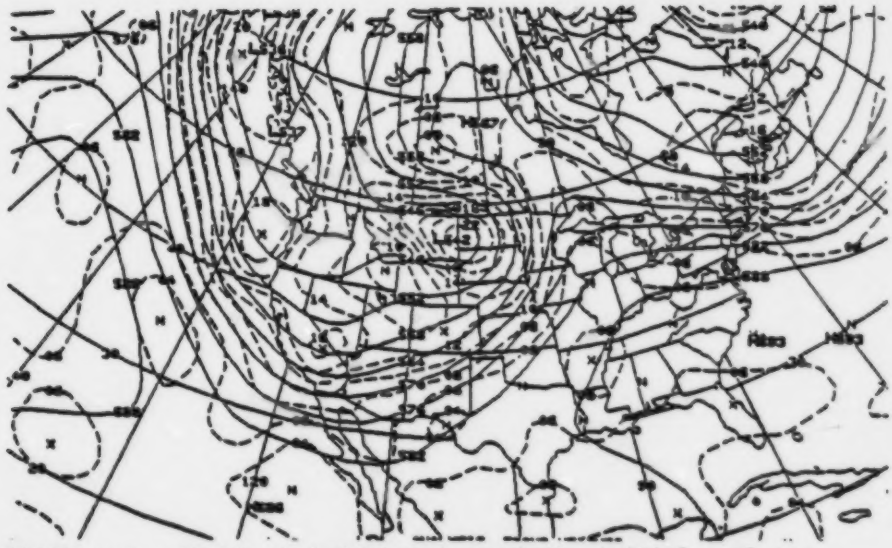


FIGURE 3.5 LFM 500 mb height and vorticity initial analysis.
06:00 CST September 25

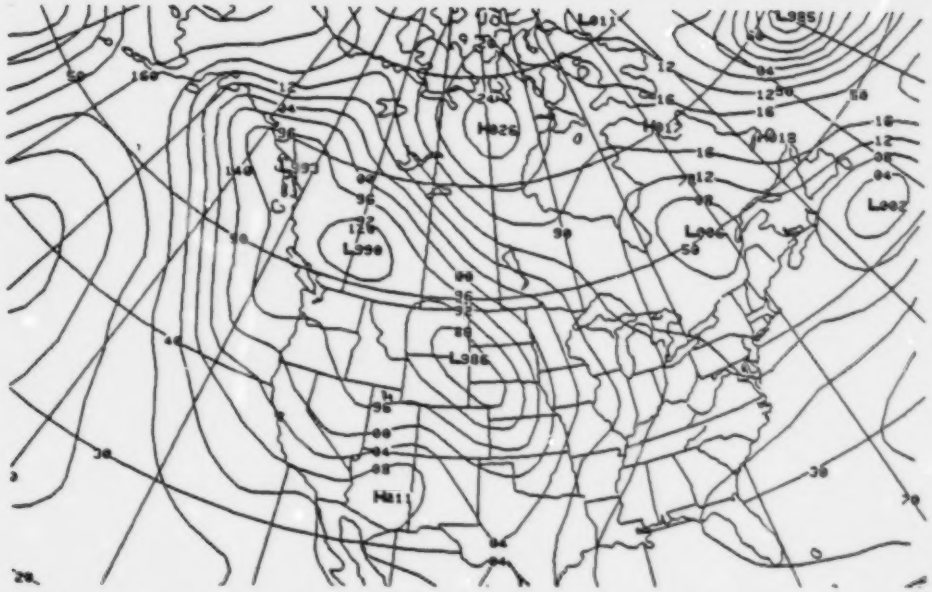


FIGURE 3.6 LFM sea level pressure initial analysis.
18:00 CST September 24

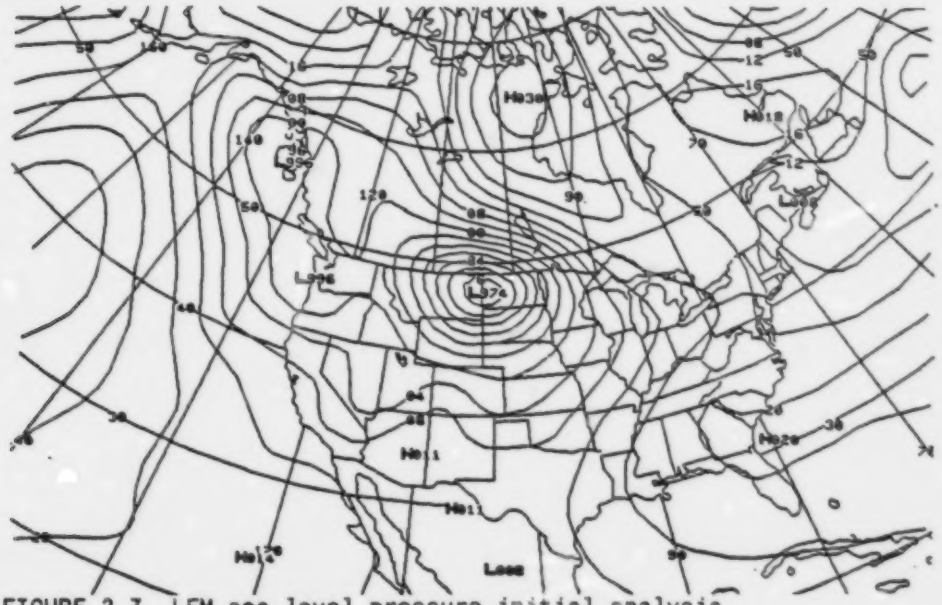


FIGURE 3.7 LFM sea level pressure initial analysis.
06:00 CST September 25

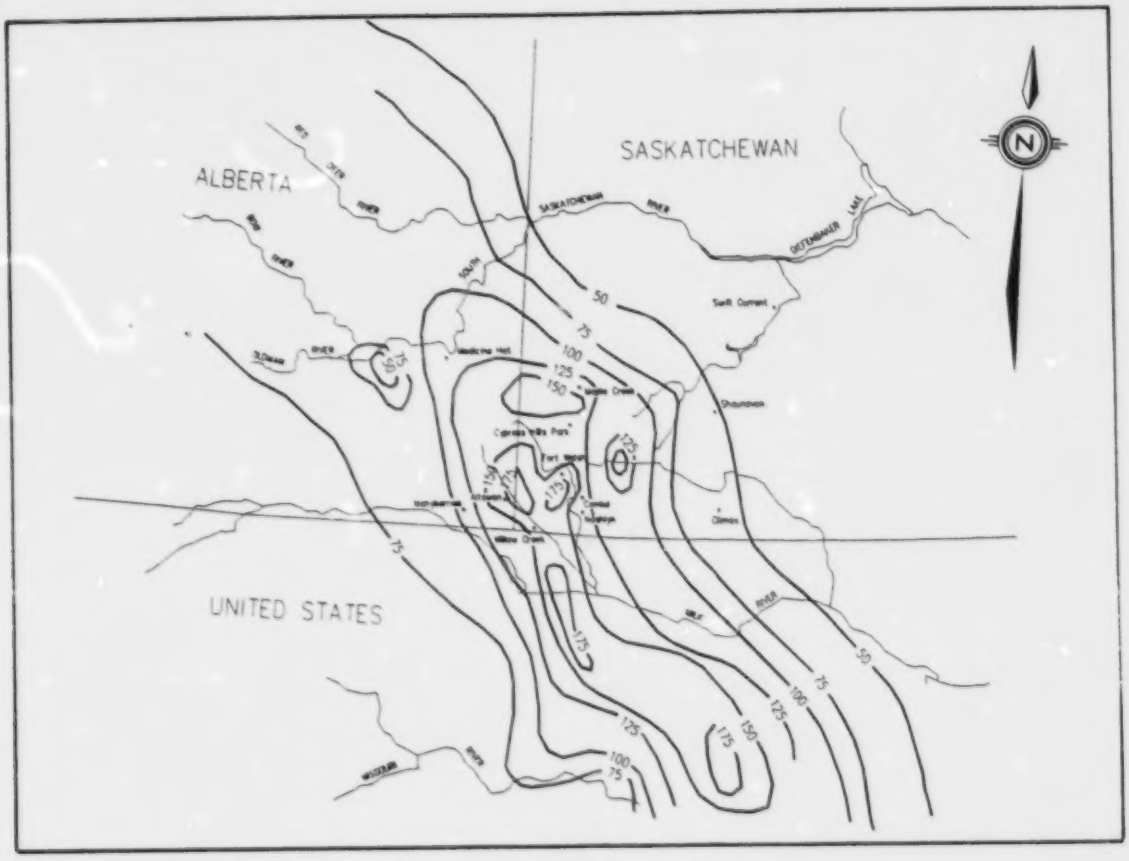


FIGURE 3.8 Isohyetal map showing accumulated precipitation during the 48 hour period September 24-26.

RECORDED PRECIPITATION
(mm)
September 24 - 26, 1986

FIGURE 3.9

CUMULATIVE RAINFALL DATA
STUDY AREA

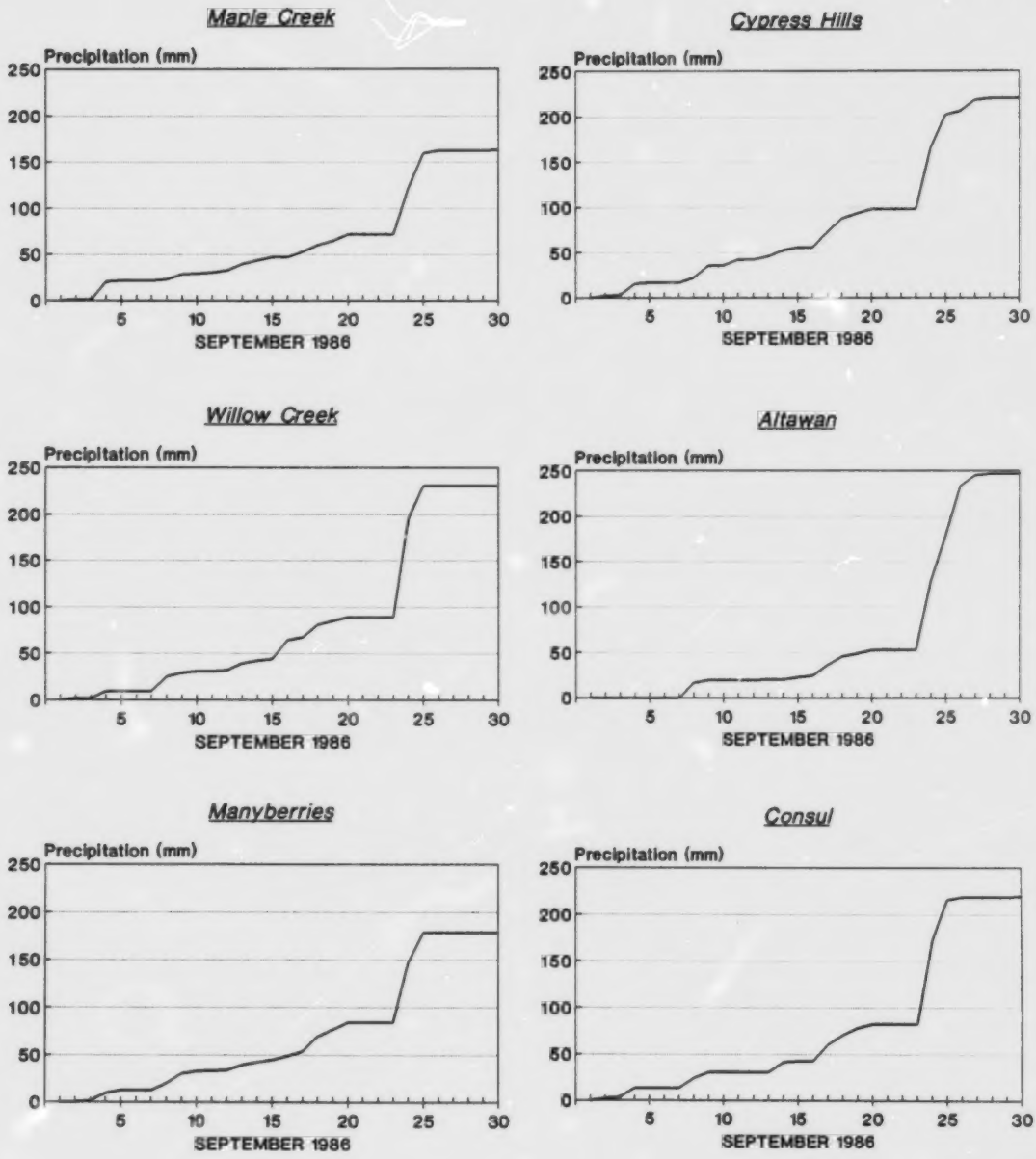


Figure 3.10

SEPTEMBER PRECIPITATION
Comparison of 1986 to September Normals and Previous Maximums

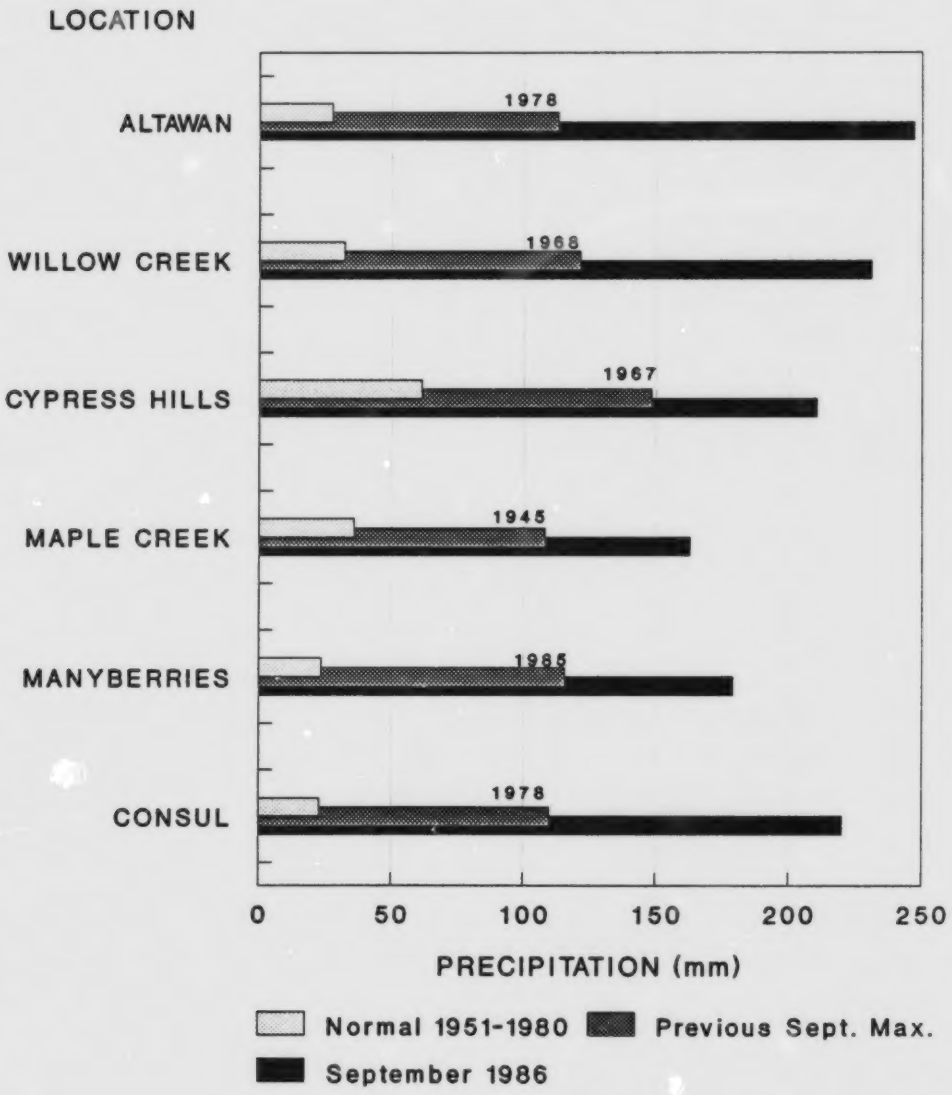


Figure 3.11

4. HYDROMETRIC ANALYSIS

Sixteen stations within the study area have been selected for analysis to indicate the magnitude and timing of the flood event. An overview of data included in the analysis is given below and detailed station data are given in Appendix B.

4.1. STATION DESCRIPTIONS

Station names and identification numbers, detailed locations, drainage areas, stage and discharge records, period of record and recorded maximums for each station are given in Appendix B.

The location of the study area and individual station locations are shown in Figure 1.1. The descriptive data given in Appendix B lists each location according to latitude, longitude and legal land location. Each station is also referenced to the nearest community.

The drainage area listed is the gross drainage area (GDA). For a storm of this magnitude it is assumed that the GDA constitutes the contributing area. Stations located on canals and ditches which receive diversion waters do not have a drainage area listed.

The method of stage measurement is given for each station. All the stations involved with this analysis contain float activated A-35 or A-71 Steven's recorders.

The method of determining the stage-discharge relationship is given. Most commonly used are wading and cableway measurements using a flow meter.

The maximum daily and, where available, maximum instantaneous discharges are given for each station. The greatest and second greatest values are given for comparison. If different from the above, the September 1986 maximums are also given.

4.2. DISCHARGES

4.2.1. Historical Peak Discharges

For each station maximum daily and, where available, maximum instantaneous discharges have been plotted for the period of record. While it is known that most of the stations in the study area are affected by streamflow regulation, the degree of effect that this regulation has had on recorded peaks during the period of measurement is uncertain. Their plots have been included to indicate the magnitude of flows which have previously occurred at each station, regardless of cause.

4.2.2. Daily Discharges

Hydrographs of the daily recorded flow during September, 1986 are given for each station. Their inclusion allows for a visual comparison of the magnitude of flows prior to and during flood activity. Individual daily flows for 1986 for each station are also provided in tabular format (Appendix B). September, 1986 daily values for stations analyzed in the Battle Creek and Lodge Creek drainage basins are summarized in Tables 4.1a and 4.1b, respectively. Lyons Creek data are included in Table 4.1b. The largest daily flow (220 m^3/s) in the region occurred at station Lodge Creek below McRae Creek at International Boundary (11AB083).

4.2.3. Hourly Instantaneous Discharge

Where data permitted, the hourly values as recorded during the storm period were plotted. The hourly values represent the instantaneous discharge at the beginning of each hour and are not the mean of a one hour period. In order to ensure the validity of such values, care was taken to ascertain that values do in fact represent the changing conditions during storm activity. In cases where the hydrograph showed a reduction along the rising limb the original recorder charts were checked. In some cases two distinct peaks were observed. This may be due to increased localized precipitation intensity or to tributary effects. The two peaks can most readily be seen on graphs for stations Lodge Creek near Alberta Boundary (11AB082) and Lodge Creek below McRae Creek at International Boundary (11AB083). Hourly values are also provided in tabular format and included with station data in Appendix B.

4.2.4. Flood Peak Discharges

The two greatest peaks were recorded at stations Lodge Creek below McRae Creek at International Boundary (11AB083) and Battle Creek at International Boundary (11AB027). The effects of upstream flow on the flood peaks on these two stations is looked at in detail in sections 4.2.4.1 and 4.2.4.2, respectively. A summary of the peaks at all stations in the area is given in Table 4.2. Figure 4.1 allows for a visual comparison of maximum instantaneous flows recorded during the period of record and during the September 1986 flood event.

Due to the unexpected occurrence of high flows in September, as well as high winds and flooding, not all stations were measured at, or near, their peak discharge. In cases where peak flows rose above the

SUMMARY
DAILY DISCHARGE (m3/s) SEPTEMBER 1986
Battle Creek Drainage Basin

DATE	BATTLE CR AT ALBERTA BOUNDARY	BATTLE CR BELOW WILSON'S WEIR	BATTLE CR NEAR CONSUL	BATTLE CR BELOW NASHLYN PROJECT	BATTLE CR AT INTERNATIONAL BOUNDARY	CYPRESS LAKE WEST INFLOW	CYPRESS LAKE WEST OUTFLOW	NASHLYN CANAL AT CONSUL
	11AB117	11AB118	11AB096	11AB101	11AB027	11AB078	11AB077	11AB018
1	0.197	0.199	0.140	0.097	0.044	0	0	0
2	.193	.218	.145	.094	.041	0	0	0
3	.199	.447	.151	.103	.046	0	0	0
4	.240	.516	.142	.098	.064	0	0	0
5	.311	.391	.151	.127	.061	0	0	0
6	.324	.349	.277	.132	.064	0	0	0
7	.288	.325	.306	.143	.073	0	0	0
8	.292	.335	.263	.221	.075	0	0	0
9	.339	.363	.288	.343	.106	0	0	0
10	.419	.389	.318	.333	.154	0	0	0
11	.322	.435	.326	.317	.286	0	0	0
12	.315	.467	.312	.307	.256	0	0	0
13	.342	.514	.338	.321	.252	0	0	0
14	.365	.542	.402	.327	.263	0	0	0
15	.378	.561	.471	.369	.286	0	.002	0
16	.373	.851	.480	.428	.286	0	.003	0
17	.600	.893	.514	.503	.356	0	.007	0
18	.573	.921	.843	.565	.460	0	.007	0
19	.605	1.17	.917	.749	.552	.014	.011	0
20	.622	.731	.934	.956	.634	.700	.011	0
21	.563	.536	.985	.918	.821	.711	.009	0
22	.489	.393	.642	1.04	.787	.905	.006	0
23	.488	.335	.540	.808	.846	.578	.005	0
24	.467	.359	.489	.631	.755	.635	.007	0
25	4.95	1.93	4.93	10.7	117.	13.2	.369	1.12
26	3.28	.354	23.5	40.8	64.9	11.2	.913	.74
27	1.72	.270	9.12	28.7	46.8	10.4	.407	.038
28	1.25	.094	4.98	14.0	24.0	5.73	.070	.015
29	1.01	.009	3.60	8.65	12.9	3.95	.045	0
30	.816	.008	3.11	5.84	8.87	3.31	.026	0

TABLE 4.1a

SUMMARY
DAILY DISCHARGE (m3/s) SEPTEMBER, 1986
Lodge and Lyons Creek Drainage Basins

DATE	MIDDLE CR NR SASKATCHEWAN BOUNDARY	MIDDLE CR BELOW MIDDLE CR RESERVOIR	MIDDLE CR AT GOVENLOCK	MIDDLE CR ABOVE LODGE CREEK	LODGE CR AT ALBERTA BOUNDARY	Squaw* Coulee	LODGE CR AT INTERNATIONAL BOUNDARY	LYONS CR AT INTERNATIONAL BOUNDARY
	11AB009	11AB001	11AB108	11AB008	11AB082	11AB103	11AB083	11AB075
1	.009	0	0	0	0	0	0	0
2	.011	0	0	0	0	0	0	0
3	.013	0	0	0	0	0	0	0
4	.018	0	0	0	0	0	0	0
5	.020	0	0	0	0	0	0	0
6	.020	0	0	0	0	0	0	0
7	.020	0	0	0	0	0	0	0
8	.017	0	0	0	0	0	0	0
9	.016	0	0	0	0	0	0	0
10	.018	0	0	0	0	0	0	0
11	.018	0	0	0	0	0	0	0
12	.016	0	0	0	0	0	0	0
13	.015	0	0	0	0	0	0	0
14	.015	0	0	0	0	0	0	0
15	.016	0	0	0	0	0	0	0
16	.016	0	0	0	0	0	0	0
17	.020	0	0	0	0	0	0	0
18	.021	0	0	0	0	0	0	0
19	.020	0	0	.020	0	0	.001	0
20	.018	0	0	.010	.034	0	.033	0
21	.014	0	0	.007	.025	0	.034	0
22	.013	0	0	.002	.011	0	.017	0
23	.011	0	0	0	.007	0	.009	0
24	.011	0	0	.003	.024	0	.005	0
25	4.12	0	19.0	8.81	84.3	*	140.	18.8
26	11.2	1.39	20.5	19.5	119.	*	220.	12.4
27	3.5	.674	4.98	12.8	51.7	4.3	136.	7.04
28	1.10	.040	2.04	6.99	16.2	1.74	47.3	5.18
29	.497	.003	1.11	3.67	6.09	.933	21.8	3.46
30	.219	.001	.71	1.96	4.1	.585	10.8	2.77

TABLE 4.1b

* RECORD LOST FOR SEPT 25, 26

measuring capabilities of the station, and where measurements could not be taken at peak discharge, the maximum flow was determined using slope-area measurements and graphical extension.

4.2.4.1. Lodge Creek below McRae Creek at International Boundary (11AB083) This station was not accessible during the flood event. The bridge on Highway 21 was washed out and heavy winds prevented the slinging of a boat to the site by helicopter. As soon as access was possible the high water marks were staked out and a slope-area survey conducted. A peak discharge of 280 m^3/s (19:00 CST September 25) was determined from the slope-area measurements (Yee, 1988). A second, lessor peak of approximately 235 m^3/s occurred the following day (18:00 CST September 26).

Flow at this station is affected by flow from Squaw Coulee, Altawan Reservoir (which is located on Lodge Creek), Middle Creek and McRae Creek. At station Squaw Coulee near Willow Creek (11AB103) stage rose above the measuring capabilities of the station and water overflowed the road and bridge below the gauge, washing out the right bridge abutment. An attempt was made to extend the head-discharge curve using head-velocity and head-area relationships. Extensive backwater caused by the road and bridge prevented a conclusive determination of flow and as a result no estimates have been made for flows on September 25 or 26. While flow from Squaw Coulee is not believed to have played a role in the peak September 25 flow at Lodge Creek at International Boundary it is possible that it contributed to the second, lessor peak on September 26.

Altawan Reservoir did not affect the peak at Lodge Creek below McRae Creek at International Boundary (11AB083). The stage in Altawan Reservoir began increasing at approximately 0:00 CST September 25 and peaked (Peak elevation 901.630 m) at 04:57 CST September 26 (Figure 4.2). The flow from Altawan Reservoir to Lodge Creek below McRae Creek at International Boundary (11AB083) has a two day time lag, so even if the reservoir had not been in place flow could not have reached the station Lodge Creek at International Boundary in time to contribute to the peak flow, which occurred at 19:00 CST September 25.

Several stop-logs were removed at the reservoir's outlet at 14:10 CST September 26 in an effort to reduce reservoir surcharge. Due to high pressure on the stop-logs not all were removed.

SUMMARY OF PEAK FLOWS

STATION DESCRIPTION	STATION NUMBER	GDA km2	DISCHARGE: RECORDED EXTREMES (m^3/s) FOR PERIOD OF RECORD				SEPTEMBER 1986				
			MAX INST	DATE	MAX DAILY	DATE	MAX INST	DATE	TIME (CST)	MAX DAILY	DATE
LODGE CR AT ALBERTA BOUNDARY	11AB082	909	137	1952 04 16	110	1952 04 04	177	26	0037	119	26
MIDDLE CREEK BELOW MIDDLE CREEK RESERVOIR	11AB001	385	4.08	1972 06 23	47.9	1912 04 05	-	-	-	1.39	26
MIDDLE CREEK NEAR SASKATCHEWAN BOUNDARY	11AB009	305	34.5	1969 04 07	72.5	1952 04 15	16.0	26	0137	-	-
MIDDLE CREEK NEAR GOVENLOCK	11AB108	655	18.4	1986 09 25	12.1	1986 09 26	33.8	25	1831	20.5	26
MIDDLE CREEK ABOVE LODGE CREEK	11AB008	717	19.8	1962 06 14	33.1	1922 04 24	20.9	26	1240	19.5	26
SQUAW COULEE NEAR WILLOW CREEK[1]	11AB103	102	6.82	1982 05 30	4.55	1982 05 30	-	-	-	4.30	27
LODGE CREEK AT INTERNATIONAL BOUNDARY	11AB083	2 140	220	1962 06 14	129	1962 06 14	280	25	1900	220	26
BATTLE CREEK AT ALBERTA BOUNDARY	11AB117	117	45.4	1985 04 28	19.8	1979 04 17	7.09[2]	25	1100	4.95	25
BATTLE CREEK BELOW WILSON'S WEIR	11AB118	-	15.7	1985 04 30	10.9	1985 04 30	9.28[2]	25	1100	1.93	25
CYPRESS LAKE WEST INFLOW	11AB078	-	-	-	25.0	1965 04 27	-	-	-	13.2	25
CYPRESS LAKE WEST OUTFLOW	11AB077	-	-	-	8.61	1951 05 04	-	-	-	.913	26
BATTLE CREEK NEAR CONSUL	11AB096	1 850	68.8	1967 05 20	66.0	1967 05 20	28.1	26	1235	23.5	26
NASHLYN CANAL NEAR CONSUL	11AB018	-	-	-	2.41	1952 04 14	3.14[2]	25	2100	1.12	25
BATTLE CREEK BELOW NASHLYN PROJECT	11AB101	2 210	35.1	1972 06 10	27.4	1972 06 10	45.1	26	1044	40.8	26
BATTLE CREEK AT INTERNATIONAL BOUNDARY	11AB027	2 580	165	1952 04 15	158	1952 04 15	277	25	1300	117	25
LYONS CREEK AT INTERNATIONAL BOUNDARY	11AB075	174	34.5	1955 07 06	22.5	1952 04 07	39.6	25	1300	18.8	25

(1) SEPT 25, 26 1986 FLOWS MISSED, HEAD-DISCHARGE RELATIONSHIP NOT DEFINED ABOVE 7.19 m^3/s

(2) REPRESENTS MAXIMUM HOURLY DISCHARGE WHERE MAXIMUM INSTANTANEOUS NOT AVAILABLE

TABLE 4.2

COMPARISON OF PEAK FLOWS

Historical and September 1986 Peaks

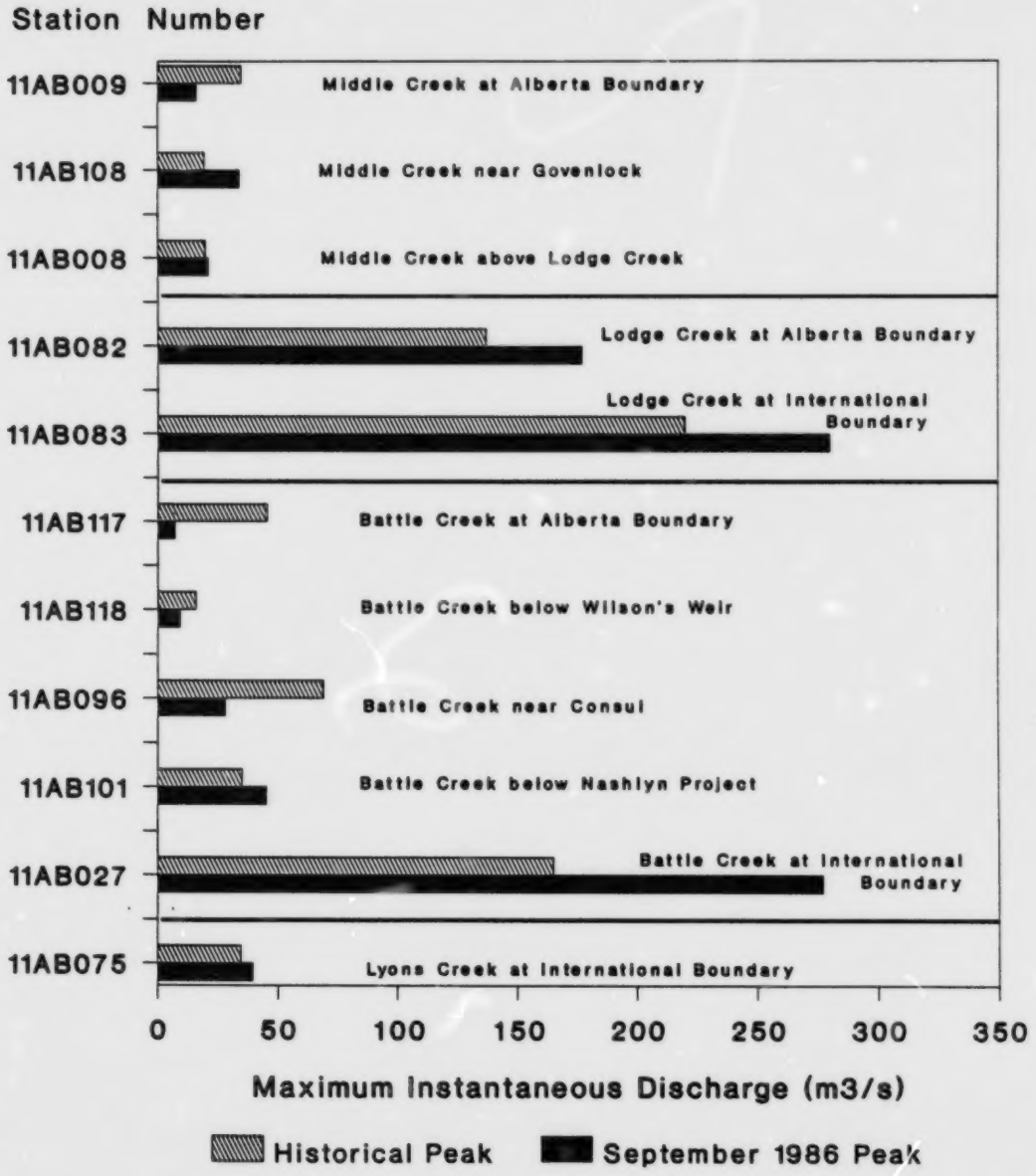


Figure 4.1

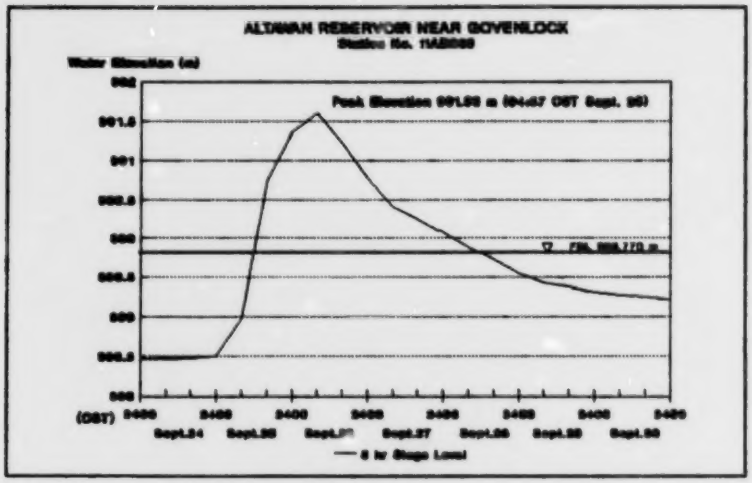


FIGURE 4.2

The peak at the upstream station Lodge Creek at Alberta Boundary (11AB082) occurred at 00:37 CST September 26, approximately 5.5 hours after the peak at the downstream station Lodge Creek below McRae Creek at International Boundary, indicating that the storm moved up the drainage basin. It also shows that the peak at Lodge Creek below McRae Creek at International Boundary (11AB083) was not affected by flows from the upper reaches of the Lodge Creek drainage basin.

Flow from Middle Creek did not play a role in the formation of the peak flow at Lodge Creek below McRae Creek at International Boundary (11AB083). Peak flow at station Middle Creek above Lodge Creek (11AB008) occurred at 12:40 CST September 25. Flow from this station to Lodge Creek at the International Boundary (11AB083) has approximately a one day time lag. Therefore it may have contributed to the second, lessor peak at the International boundary which occurred 24 hours after the first.

No gauging station exists on McRae Creek so the magnitude and impact of its flows on the peak at Lodge Creek below McRae Creek at the International Boundary (11AB083) is unknown.

4.2.4.2. Battle Creek at International Boundary (11AB027) This station was also inaccessible during the flood event. High water marks were staked out the day following the peak event and a slope-area survey was

later conducted. A peak discharge of 277 m^3/s (13:00 CST September 25) was calculated from the survey (Yee,1988).

Flow at this station is influenced by flow from Adams Lake and Cypress Lake, located in the upper and middle reaches of the drainage basin, respectively. When these flows were routed downstream the peak flow at this station increased negligibly. No unmeasured flows entered Battle Creek as all tributaries were actively being monitored and no records were lost. As in the Lodge Creek drainage basin, peak flow in Battle Creek was not influenced by drainage from the upper reaches of the drainage basin. Peak flows at stations upstream of this station occurred either after or too late to have been a contributing factor in the peak of September 25.

4.2.5. Natural Flow

Due to the high degree of regulation in the study area an attempt was made to determine the natural flow which would have occurred had diversion structures not been in place. Values are tabulated and shown in Table 4.3. Methods for estimating natural flows are given in Appendix B with each station for which estimations were made, and plots of natural flow are combined with the plots of recorded flow for individual stations. This exercise allows for an estimation of the impact which regulation has on flood flow in the system.

A schematic of the Lodge Creek drainage basin is given in Figure 4.3. Natural flow estimations could only be calculated for stations Middle Creek near Saskatchewan Boundary (11AB009) and Middle Creek below Middle Creek Reservoir (11AB001). Insufficient data prevented other estimations.

A schematic of the Battle Creek basin is given in Figure 4.4. Natural flow estimations were made for five stations located on Battle Creek. Anthropogenic impact on Battle Creek was due only to Adams Lake storage and diversion occurring at the Cypress Lake West Inflow Canal.

SUMMARY
NATURAL DISCHARGE ESTIMATIONS (m3/s)

SEPT 1986	MIDDLE CR BELOW MIDDLE CR RESV 11AB001	BATTLE CR BELOW WILSON'S WEIR 11AB118	BATTLE CR NEAR CONSUL 11AB088	BATTLE CR BELOW NASHLYN PROJECT 11AB101	BATTLE CR AT INTERNATIONAL BOUNDARY 11AB027
1	0	.199	0.140	0.097	.044
2	0	.218	.145	.094	.041
3	0	.447	.151	.103	.046
4	0	.516	.142	.098	.064
5	0	.391	.151	.127	.061
6	0	.349	.277	.132	.084
7	0	.325	.306	.143	.073
8	0	.335	.263	.221	.075
9	0	.363	.288	.343	.106
10	0	.389	.318	.333	.154
11	0	.435	.326	.317	.286
12	0	.467	.312	.307	.256
13	0	.514	.338	.321	.252
14	0	.542	.402	.327	.263
15	0	.561	.471	.369	.286
16	0	.651	.477	.428	.288
17	0	.693	.511	.501	.356
18	0	.921	.836	.565	.458
19	0	1.18	.910	.742	.549
20	0	1.43	.906	.949	.627
21	0	1.25	1.64	.904	.810
22	0	1.30	1.31	1.67	.773
23	0	0.913	1.41	1.45	.836
24	0	.984	1.03	1.47	1.37
25	1.01	15.13	5.53	11.21	117.81
26	5.51	12.57	38.28	41.37	65.38
27	11.82	11.69	20.38	41.45	46.96
28	3.48	5.62	15.93	25.18	36.17
29	1.05	3.96	9.29	19.54	24.54
30	0.44	3.32	6.98	11.50	20.11

TABLE 4.3

4.3. FREQUENCY ANALYSIS

Stations receiving a negligible amount of interference from regulation were selected for frequency analysis in order to determine approximate recurrence intervals and corresponding flood magnitudes. The Consolidated Frequency Analysis (CFA) software package was used in the analysis.

Frequency analysis was initially conducted on sixteen stations in the study area but as significant trend was noted among stations located on drainage and diversion canals their results have not been included in this report. Included in Appendix B are the sample statistics and frequency regimes for six stations.

September of 1986 was one of the few times that an annual peak was the result of rainfall, rather than the result of meltwater runoff, at most of the stations. Precipitation induced peaks and peaks resulting from spring runoff are from different

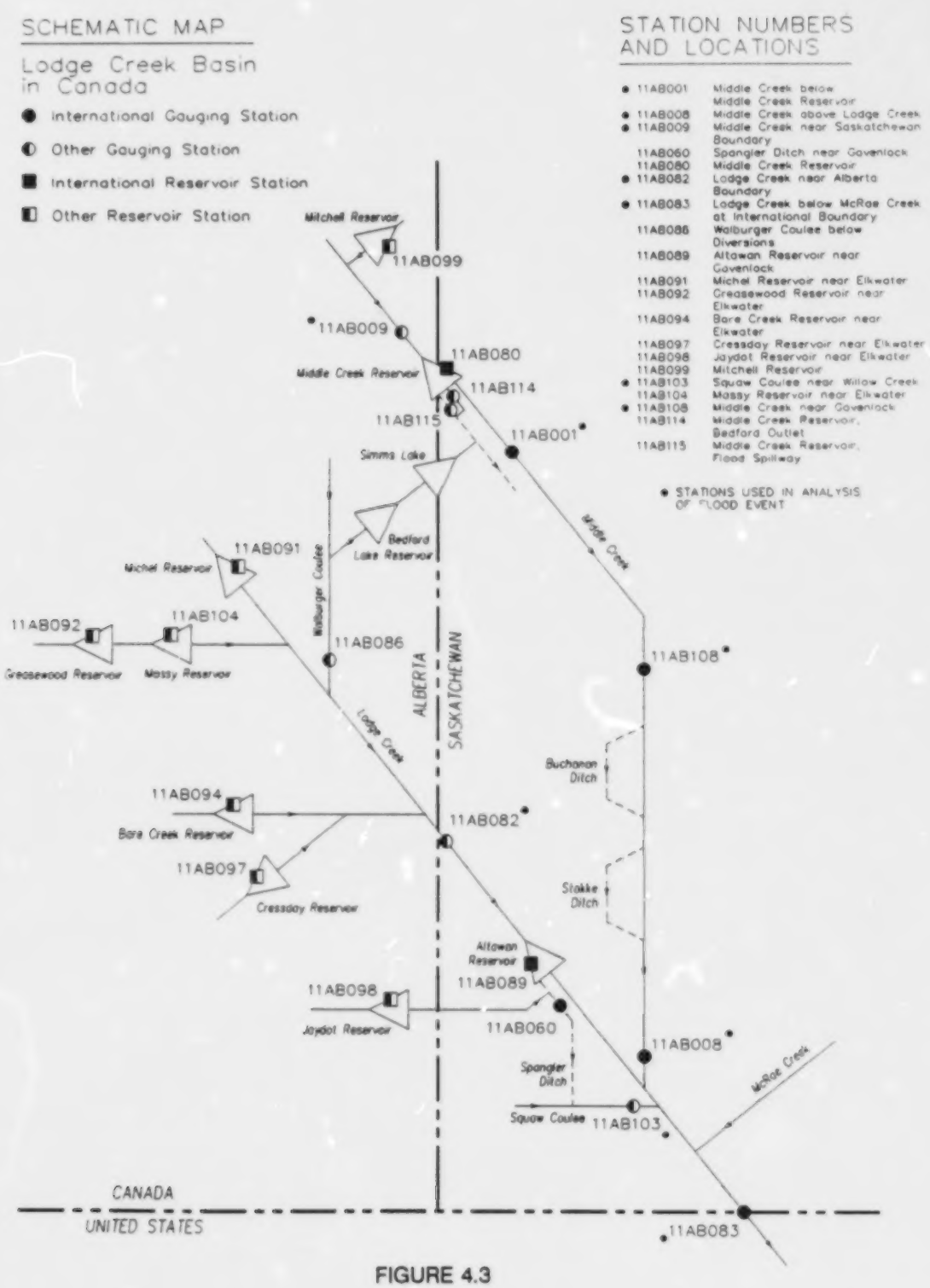

SCHEMATIC MAP
Lodge Creek Basin in Canada
International Gauging Station
Other Gauging Station
International Reservoir Station
Other Reservoir Station
STATION NUMBERS AND LOCATIONS
• 11AB001 Middle Creek below Middle Creek Reservoir
• 11AB008 Middle Creek above Lodge Creek
• 11AB009 Middle Creek near Saskatchewan Boundary
11AB060 Spangler Ditch near Govenlock
11AB080 Middle Creek Reservoir
• 11AB082 Lodge Creek near Alberta Boundary
• 11AB083 Lodge Creek below McRae Creek at International Boundary
11AB086 Walburger Coulee below Diversions
11AB089 Altawan Reservoir near Govenlock
11AB091 Michel Reservoir near Elkwater
11AB092 Greasewood Reservoir near Elkwater
11AB094 Bare Creek Reservoir near Elkwater
11AB097 Cressday Reservoir near Elkwater
11AB098 Jaydot Reservoir near Elkwater
11AB099 Mitchell Reservoir
• 11AB103 Squaw Coulee near Willow Creek
11AB104 Massy Reservoir near Elkwater
• 11AB108 Middle Creek near Govenlock
11AB114 Middle Creek Reservoir, Bedford Outlet
11AB115 Middle Creek Reservoir, Flood Spillway
• STATIONS USED IN ANALYSIS OF FLOOD EVENT
Mitchell Reservoir
11AB099
11AB009
11AB080
Middle Creek Reservoir
11AB114
11AB115
11AB001
Simms Lake
Bedford Lake Reservoir
Middle Creek
11AB091
Michel Reservoir
Walburger Coulee
11AB092
11AB104
11AB086
Greasewood Reservoir
Massy Reservoir
ALBERTA
SASKATCHEWAN
11AB108
Lodge Creek
Buchanon Ditch
11AB094
Bare Creek Reservoir
11AB082
11AB097
Cressday Reservoir
Stokke Ditch
Altawan Reservoir
11AB089
11AB098
Jaydot Reservoir
11AB060
11AB008
Spangler Ditch
McRae Creek
Squaw Coulee
11AB103
CANADA
UNITED STATES
11AB083

FIGURE 4.3

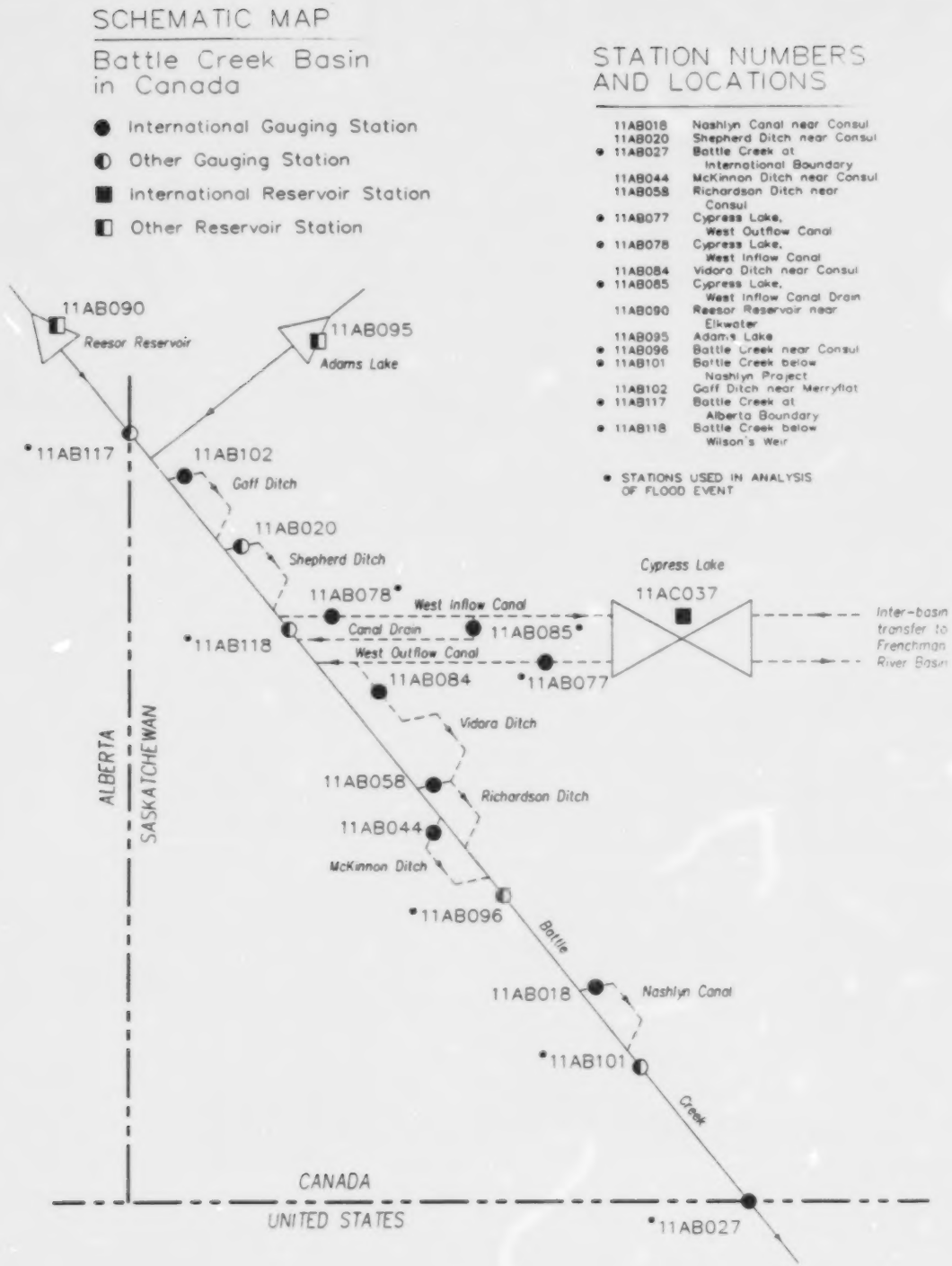

SCHEMATIC MAP
Battle Creek Basin in Canada
International Gauging Station
Other Gauging Station
International Reservoir Station
Other Reservoir Station
STATION NUMBERS AND LOCATIONS
11AB018 Nashlyn Canal near Consul
11AB020 Shepherd Ditch near Consul
• 11AB027 Battle Creek at International Boundary
11AB044 McKinnon Ditch near Consul
11AB058 Richardson Ditch near Consul
• 11AB077 Cypress Lake, West Outflow Canal
• 11AB078 Cypress Lake, West Inflow Canal
11AB084 Vidora Ditch near Consul
• 11AB085 Cypress Lake, West Inflow Canal Drain
11AB090 Reesor Reservoir near Elkwater
11AB095 Adams Lake
• 11AB096 Battle Creek near Consul
• 11AB101 Battle Creek below Nashlyn Project
11AB102 Gaff Ditch near Merryflat
• 11AB117 Battle Creek at Alberta Boundary
• 11AB118 Battle Creek below Wilson's Weir
• STATIONS USED IN ANALYSIS OF FLOOD EVENT
11AB090
Reesor Reservoir
11AB095
Adams Lake
•11AB117
11AB102
Gaff Ditch
11AB020
Shepherd Ditch
11AB078•
West Inflow Canal
Canal Drain
11AB085•
•11AB118
West Outflow Canal
11AB084
•11AB077
Cypress Lake
11AC037
Inter-basin transfer to Frenchman River Basin
Vidora Ditch
11AB058
Richardson Ditch
11AB044
McKinnon Ditch
•11AB096
Battle
11AB018
Nashlyn Canal
•11AB101
Creek
ALBERTA
SASKATCHEWAN
CANADA
UNITED STATES
•11AB027

FIGURE 4.4

statistical populations, and the exact effect of combining the two populations on the calculated flood return periods was not quantified. It is safe to say, however, that the probability of a similar flow due to rainfall occurring again in September is much less than the probability of similar flow occurring due to meltwater runoff.

4.3.1. Battle Creek at Alberta Boundary (11AB117)

Station Battle Creek at Alberta Boundary (11AB117) is influenced by Reesor Reservoir, located upstream of the station. However, because of the reservoir's small capacity and drainage area (3% of the gross drainage area as measured at 11AB117) the effects of regulation on recorded flows at this station are minimal.

Analysis was conducted using annual maximum instantaneous flows, which are available for the period 1975 to present. Only 8% of past recorded peaks have occurred in June or later, which are assumed to be the result of precipitation runoff rather than the result of meltwater runoff. The event peak on September 25 of approximately 7 m^3/s has a probability of occurence of about 1 in 1 year. The maximum instantaneous flow for 1986 at this station occurred in February.

Sample statistics, frequency regime and corresponding frequency plot are included in Appendix B along with other gauging station data.

4.3.2. Battle Creek below Wilson's Weir (11AB118)

During the period 1939 to 1987 three different stations were located along Battle Creek in the vicinity of the Cypress Lake West diversion canals - station Battle Creek above Cypress Lake West Inflow Canal (11AB076), station Battle Creek below Cypress Lake West Drainage Canal (11AB100), and the present station of Battle Creek below Wilson's Weir (11AB118). Station locations are shown in Figure 4.5.

Maximum instantaneous flow records are not available for each station for all years. In order to extend the period of record to provide a longer data base for frequency analysis the maximum daily flow recorded at each of the stations was corrected to represent maximum instantaneous flow at the present station location of Battle Creek below Wilson's Weir (11AB118).

From 1939 to 1966 maximum instantaneous flows as measured at Battle Creek above Cypress Lake West Inflow

STATION LOCATIONS
West Cypress Lake Diversion Canals

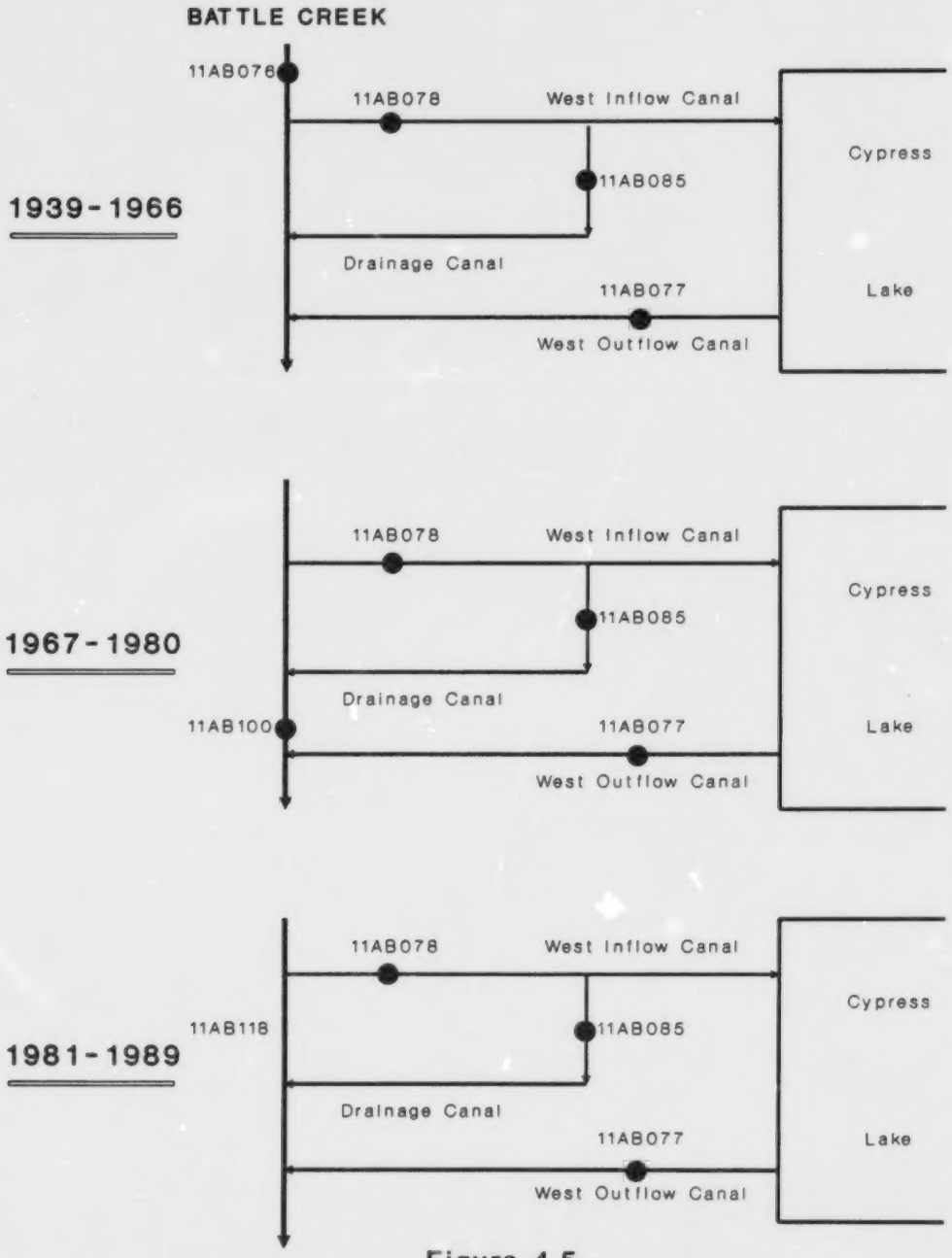


Figure 4.5

Canal (11AB076) are available . This flow was corrected to represent flow at Battle Creek below Wilson's Weir (11AB118) by applying a correction factor based on the ratio of the two drainage areas.

From 1967 to 1980 flow was measured at Battle Creek above Cypress Lake West Inflow Canal (11AB100). Flow at this station was influenced by diversion of water to Cypress Lake. Maximum daily flows due to natural runoff were estimated by the addition and subtraction of same day flows as measured at Cypress Lake West Inflow and Outflow Canals (11AB078 and 11AB085 respectively). These values were then corrected for the change in drainage area to represent maximum daily flow at Battle Creek below Wilson's Weir (11AB118).

From 1981 to 1987 maximum daily flows were calculated for the present station by summing same day flows as measured at Cypress Lake West Outflow Canal (11AB078) and Battle Creek below Wilson's Weir (11AB118).

The maximum instantaneous flow at Battle Creek below Wilson's Weir (11AB118), for the period 1967 to 1987, was then estimated from the calculated maximum daily flows by two methods. The first was the Fuller Method. This method has been widely used due to: 1) its simplicity, and 2) a lack of alternative methods. Results are shown in Table 4.4. The second method was based on the relationship between maximum daily and maximum instantaneous flows as measured at Battle Creek above Cypress Lake West Inflow Canal (11AB076) during the period 1939 to 1966. When these values were plotted (Figure 4.6) regression analysis yielded a correlation of 0.989 for maximum daily flows up to 47 m^3/s. With this correlation the calculated maximum daily flows determined for station Battle Creek below Wilson's Weir (11AB118) were corrected to maximum instantaneous flows. The maximum instantaneous values obtained are also included in Table 4.4.

Only 12% of past recorded peaks at this station have occurred in June or later. The event peak on September 25 at station Battle Creek below Wilson's Weir (11AB118) of approximately 9 m^3/s has a probability of occurrence of about 1 in 6 years.

The frequency regime, corresponding frequency plot and sample statistics are included in Appendix B with other station data.

TABLE 4.4

ESTIMATION OF NATURAL MAXIMUM DISCHARGE
BATTLE CREEK BELOW WILSON'S WEIR
STATION 11AB118

DATE	ESTIMATED NATURAL MAXIMUM DAILY DISCHARGES (m^3/s)	ESTIMATED NATURAL MAXIMUM INSTANTANEOUS DISCHARGE		
		DRAINAGE AREA METHOD (m^3/s)	FULLER METHOD* (m^3/s)	LINEAR REGRESSION METHOD (m^3/s)
1939	7.58	-	-	9.04
1940	37.73	47.1	-	-
	10.56	12.2	-	-
	22.57			29.0
	26.33	-	-	34.01
	5.04	-	-	5.66
1945	6.94	11.1	-	-
	13.22	18.47	-	-
	11.97	14.5	-	-
	22.34	26.3	-	-
	2.06	3.4	-	-
1950	15.73	19.0	-	-
	28.84	31.1	-	-
	90.06	-	-	118.87
	53.58	76.1	-	-
	8.85	12.1	-	-
1955	31.69	41.3	-	-
	4.94	6.4	-	-
	20.98	23.6	-	-
	12.54	15.4	-	-
	7.88	9.85	-	-
1960	13.91	19.1	-	-
	1.06	2.13	-	-
	2.39	-	-	-
	8.16	-	-	-
	10.49	13.7	-	-
1965	35.45	43.9	-	-
	23.14	25.5	-	-
	72.91	-	99.54	97.10
	3.26	-	4.45	4.34
	0.44	-	0.60	0.59

TABLE 4.4 Cont'd..

TABLE 4.4

ESTIMATION OF NATURAL MAXIMUM DISCHARGE
BATTLE CREEK BELOW WILSON'S WEIR
STATION 11AB118

DATE	ESTIMATED NATURAL MAXIMUM DAILY DISCHARGES (m^3/s)	ESTIMATED NATURAL MAXIMUM INSTANTANEOUS DISCHARGE		
		DRAINAGE AREA METHOD (m^3/s)	FULLER METHOD* (m^3/s)	LINEAR REGRESSION METHOD (m^3/s)
1970	31.39	-	42.85	41.80
	9.51	-	12.98	12.60
	20.69	-	28.25	27.55
	2.96	-	4.04	3.94
	5.87	-	8.01	7.82
1975	18.15	-	24.78	24.17
	9.77	-	13.34	13.01
	3.18	-	4.34	4.23
	6.14	-	8.38	8.18
	19.30	-	26.35	25.70
1980	4.91	-	6.70	6.54
	5.94	-	8.11	7.91
	12.67	-	17.30	16.87
	4.83	-	6.59	6.43
	0.73	-	1.00	0.97
1985	17.56	-	23.97	23.38
	20.45	-	27.92	27.23
	7.44	-	10.16	9.91

*THE FULLER EQUATION IS $QP = QD\ (1 + 2A^{-0.3})$ WHERE

QP = PEAK DISCHARGE (cfs)

QL = MAXIMUM DAILY DISCHARGE (cfs)

A = DRAINAGE AREA (mi^2)

Battle Creek above Cypress Lake West Inflow Canal (11AB076) 1939-1966
Maximum Daily Vs Maximum Instantaneous

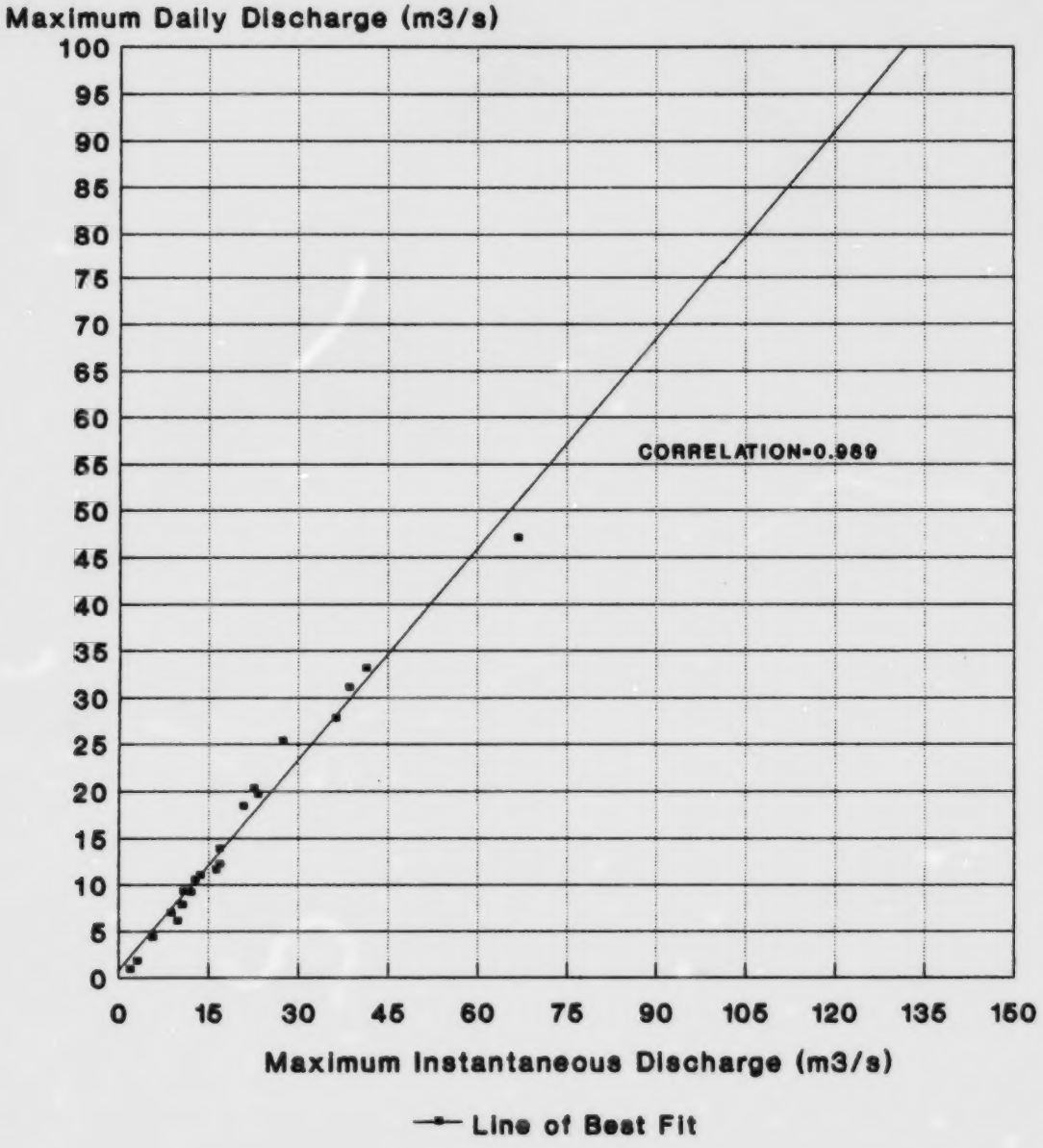


Figure 4.6

4.3.3. Battle Creek at International Boundary (11AB027)

This station is the furthest downstream Canadian station in the Battle Creek drainage basin, and is affected by flows from all upstream diversions. No major tributaries enter Battle Creek below the Cypress Lake West diversion canals, however water can be diverted to several irrigation ditches. During the normal course of operation irrigation ditches are not used in September, and flow within the ditches at this time of year is mainly due to local precipitation runoff. At this station 85% of past recorded annual maximum instantaneous flows have occurred in the period March to May, with only 15% occurring in June or later.

Analysis was conducted using maximum instantaneous flows, which are available for most years, for the period 1917 to 1987. The flood peak of 277 m^3/s was found to have a probability of occurrence of approximately 1 in 200 years.

In a previous report (Battle Creek Basin - Probable Maximum Flood, Saskatchewan Water Corporation, 1987) maximum instantaneous flows were estimated for Battle Creek at a point near the hydrometric station Battle Creek at International Boundary (11AB027). For a 1 in 500 year return period a maximum instantaneous flow of 225 m^3/s was estimated, with a probable maximum flood (PMF) instantaneous flow of 540 m^3/s. However, this analysis used flow data only up to 1984, and did not include the flood flows of September, 1986.

Neither the frequency analysis done herein, nor the frequency analysis done by the Saskatchewan Water Corporation accounted for the effects of diversions on past recorded peaks. Diversion of water to Cypress Lake began in 1939 and has continued to the present. For proper frequency analysis each peak used in the analysis must be naturalized. Naturalization of past recorded peaks was beyond the scope of this report.

The flow frequency regime, sample statistics and corresponding frequency plot are included in Appendix B with other station data.

4.3.4. Middle Creek near Saskatchewan Boundary (11AB009)

Located in the uppermost reaches of the drainage basin, flows at this site are minimally affected by regulation from Mitchell Reservoir. Maximum instantaneous flows are

available for 1967-1987. Frequency analysis showed that the flow of 16.0 m^3/s on September 26 has a probability of occurrence of approximately 1 in 3 years. Only 10% of the past recorded instantaneous peaks at this station have occurred in June or later.

The flow frequency regime, sample statistics and corresponding frequency plot are included in Appendix B with other station data.

4.3.5. Lodge Creek near Alberta Boundary (11AB082)

There are five small reservoirs in the headwaters of the Lodge Creek basin to the west and northwest of this site. As the September, 1986 storm proceeded in a southeast to northwest direction up the drainage basin peak flows at this station were minimally affected by upstream regulation in the flood event.

It was beyond the scope of this report to examine what affect the reservoirs have had on past recorded peaks, however 27% of peak flows have occurred in June or later, which is a considerably higher percentage than at other stations looked at and which could suggest that flow at this station is affected by reservoir release. It was decided, as a matter of interest, to conduct a frequency analysis despite the historical uncertainties. Based on this analysis the peak flow at this station of 177 m^3/s on September 26, 1986 has a probability of occurrence of approximately 1 in 75 years.

Frequency regime, sample statistics and corresponding frequency plot are included with other gauging station data in Appendix B.

4.3.6. Lyons Creek at International Boundary (11AB075)

As with the other stations Lyons Creek at International Boundary (11AB075) is only minimally affected by regulation, and recorded flows were considered to represent natural flow. Maximum instantaneous data is available for the period 1927-1987. The peak flow of 39.6 m^3/s on September 25 has a probability of occurrence of approximately 1 in 80 years. Approximately 13% of flows at this station have occurred in June or later.

Frequency regime, sample statistics and corresponding frequency plot are included with other station data in Appendix B.

5. CONCLUSIONS

The September, 1986 storm is the first documented case of moisture from a tropical storm affecting Saskatchewan. The event was affected by both former tropical storm Madeline and former hurricane Newton. The rarity of the September event is reflected in the storm's September probability of occurrence which ranges from 1 in 173 years to 1 in 4 800 years.

Damage due to flooding was minimal due to the sparsely populated nature of the region.

Peak flows in the area are normally due to meltwater runoff occurring in the spring. This event was all the more unusual as peak flows occurred in September.

Flood magnitude was aided by the high amount of precipitation during the first three weeks of September which soaked the soil, thereby reducing infiltration and increasing runoff when the September 24-26 storm occurred.

Two distinct peaks were observed at several hydrometric stations. It is believed that the second peak was due to tributary affects.

Anthropogenic impact on flows in the Battle Creek drainage basin was sufficiently documented to allow for natural flow estimations. The variance between recorded flow and estimated natural flow was found to be greatest for those stations in the upper reaches of the drainage basin. When flows were routed downstream it was found that, while some attenuation was noted, there was little change between recorded flows and estimated natural flows for stations in the lower reaches of the drainage basin. This would imply that localized storm precipitation was a greater causative factor in peak formation than runoff from the upper reaches.

The impact of regulation on peak flows in the Lodge Creek drainage basin cannot be assessed. Estimations of natural flow for stations in the Lodge Creek drainage basin were hampered by a lack of data detailing reservoir storage and by missing flood data from Squaw Coulee and McRae Creek.

Frequency analysis was conducted using annual maximum instantaneous discharges, most of which occurred during spring runoff, and the peak flow due to precipitation during the flood. The exact impact of comparing peak flows which have different origins is uncertain.

For proper frequency analysis the past recorded hydrometric station flows should be adjusted to represent natural flows.
The return period of the flood would change drastically if compared with past September flows. Unfortunately flow is normally either nonexistent in September or affected by reservoir release. The frequency analysis of the storm itself, rather than the flood, gives a better indication of the rarity of the event.

6. REFERENCES

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APPENDIX A

CLIMATOLOGICAL STATION
MONTHLY RECORDS
September 1986

- Altawan
- Consul
- Cypress Hills
- Eastend
- Manyberries
- Maple Creek
- Medicine Hat
- Willow Creek

PRECIPITATION MASS CURVES

- Altawan
- Medicine Lodge

MONTHLY RECORD / RÉSUMÉ MENSUEL

SEP 1986 SEPT | 3040223 ALTAVAN | ALTA / ALB | REF. 005.K01 | K 01

LAT 49 ° 14 'N LONG 110 ° 01 'W ALT 945 m

DAILY CLIMATE DATA/DONNÉES CLIMATIQUES QUOTIDIENNES

DATE	PRECIPITATION(S) R/P mm	S/N cm	P mm	TEMPERATURE °C MAX	MIN	MN	SUNSHINE INSOLATION h	DEGREE-DAYS DEGRÉ-JOURS <18°C
		N						
1				20.0	9.0	14.5		3.5
2				21.5	4.0	12.8		5.2
3				25.0	10.0	17.5		.5
4				21.0	4.0	12.5		5.5
5				17.0	-2.5	7.3		10.7
6				19.0	5.0	12.0		6.0
7				21.0	5.0	13.0		5.0
8	16.3		16.3	19.0	5.0	12.0		6.0
9	3.0		3.0	17.0	5.0	11.0		7.0
10				11.5	5.0	8.3		9.7
11				15.0	5.0	10.0		8.0
12				17.5	5.0	11.3		6.7
13	1.0		1.0	9.0	5.0	7.0		11.0
14				8.0	3.5	5.8		12.2
15	2.0		2.0	10.0	5.0	7.5		10.5
16	2.0		2.0	12.5	3.0	7.8		10.2
17	12.0		12.0	9.0	4.0	6.5		11.5
18	9.8		9.8	7.0	5.0	6.0		12.0
19	3.0		3.0	7.0	5.0	6.0		12.0
20	4.0		4.0	7.5	5.0	6.3		11.7
21				5.5	3.0	4.3		13.7
22				3.5	-2.0	0.8		17.2
23				6.5	-4.0	1.3		16.7
24	75.0		75.0	6.5	-1.5	2.5		15.5
25	50.0		50.0	5.0	-2.5	1.3		16.7
26	55.0		55.0	5.0	-3.0	1.0		17.0
27	12.0		12.0	5.0	1.0	3.0		15.0
28	2.0		2.0	5.0	-2.0	1.5		16.5
29				11.0	-2.0	4.5		13.5
30				12.0	-1.5	5.3		12.7
31								
∴		0						

MONTHLY SUMMARY / SOMMAIRE MENSUEL

PRECIPITATION(S)

	TOTAL	% OF/DE LA NORMAL(E)	EXTREME(S)
R/P	247.1	977	75.0
S/N	0.0	0	
P	247.1	895	75.0

TEMPERATURE

	MEAN °C FROM/DE LA MOY.	NORMAL(E)	EXTREME(S)
MAX	12.0	-8.3	25.0
MIN	2.7	0.7	-4.0
MN	7.4	-3.8	

SUNSHINE/INSOLATION DEG-DAYS/DEG-JOURS <18° C

	TOTAL	% POSSIBLE	% OF/DE LA NORMAL(E)
SUN/INSOL			
DEG-DYS/JRS	319.4		151

SYNOPTICS/SYNOPTIQUES

MEAN/MOYENNE

HOUR HEURE	PRESSURE PRESSION kPa STATION	PRESSURE PRESSION kPa SEA LEVEL NIVEAU DE LA MER	TEMPERATURE °C	DEW POINT POINT DE ROSÉE °C	VAPOUR PRESSURE TENSION DE VAPEUR kPa

NUMBER OF OBSERVATIONS / NOMBRE D'OBSERVATIONS

CLOUD AMOUNT NÉBULOSITÉ TENTHS/ DIXIÈMES 0-2	3-7	8-10	VISIBILITY km VISIBILITÉ <1	1-10	>10

NUMBER OF DAYS WITH/NOMBRE DE JOURS AVEC

TEMPERATURES ≤ 0°C	9
RAIN OR DRIZZLE/PLUIE OU BRUINE	14
MEASURABLE PRECIPITATION/PRÉCIPITATIONS MESURABLES	14
SNOW/NEIGE	
THUNDERSTORMS/ORAGES	
FREEZING PRECIPITATION/PRÉCIPITATIONS SE CONGÉLANT	U
HAIL/GRÊLE	U
FOG/BROUILLARD	U
SMOKE OR HAZE/FUMÉE OU BRUME SÈCHE	U
DUST OR BLOWING SAND/POUSSIÈRE OU CHASSE-SABLE ÉLEVÉE	U
BLOWING SNOW/CHASSE-NEIGE ÉLEVÉE	U

WIND/VENT

	DIRECTION	SPEED VITESSE km/h	DATE	PERCENTAGE FREQ. BY SPEED CLASS FRÉQ. (%) LA CLASSE DE VITESSE EN POURCENTAGE km/h 0	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61	MEAN SPEED IN km/h - PERCENTAGE FREQUENCY BY DIRECTION VITESSE MOYENNE EN km/h - FRÉQUENCE DE LA DIRECTION EN POURCENTAGE N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
PREVAILING/ DOMINANT																												
MAXIMUM																												
PEAK/POINTE																												

TOTAL HOURS / TOTAL DES HEURES

RECORDING RAIN GAUGE DATA/DONNÉES DES PLUVIOGRAPHES

DURATION/DURÉES	MAXIMUM AMOUNT (mm)/HAUTEUR MAXIMUM (mm) 5 min	10 min	15 min	30 min	60 min	120 min	6 h	12 h	24 h	HOURS OF RAINFALL - mm CLASSES HEURES DE PLUIE FRÉQ. PAR CLASSE mm 0.2 -2.9	3.0 -4.9	5.0 -12.9	13.0 -24.9	25.0 -49.9	50.0 +
AMOUNT/HAUTEUR															
DATE(S)															

EVAPORATION

WATER LOSS mm PERTE D'EAU	DAILY MEAN/MOYENNE QUOTIDIENNE TOTAL WIND RUN PARCOURS DU VENT km	TEMPERATURE °C WATER DE L'EAU	AIR DE L'AIR	LAKE EVAPORATION mm ÉVAPORATION DU LAC
# 58.2E	131E	8.4E	8.2E	M

EXPLANATION OF CODES/EXPLICATION DES CODES

R/P - RAINFALL/PLUIE
S/N - SNOWFALL/NEIGE
P - PRECIPITATION(S)
N - SNOW GAUGE/NIVOMÈTRE
∴ - SNOW ON GROUND/NEIGE AU SOL (cm)
* - LESS THAN 0.5%/INFÉRIEURE À 0.5%
\+ - FIRST OF SEVERAL/PREMIER DE PLUSIEURS
M - MISSING/MANQUANTE
SVL - SEVERAL/PLUSIEURS
U - NOT OBSERVED/NON OBSERVÉ
- DATA MISSING FOR ONE OR MORE DAYS/VALEURS MANQUANTES POUR UN OU PLUSIEURS JOURS
P (SUNSHINE/INSOLATION) - POLAR NIGHT/LA NUIT POLAIRE
E - ESTIMATE/ESTIMATIVE
T - TRACE(S)

A1

MONTHLY RECORD / RÉSUMÉ MENSUEL

SEP 1986 SEPT | 4031776 CONSUL | SASK / SASK | REF. 007.N03

LAT 49° 18 'N LONG 109° 31 'W ALT 930 m

DAILY CLIMATE DATA/DONNÉES CLIMATIQUES QUOTIDIENNES

DATE	PRECIPITATION(S) R/P mm	S/N cm	P mm	TEMPERATURE °C MAX	MIN	MN	SUNSHINE INSOLATION h	DEGREE-DAYS DEGRÉ-JOURS <18°C
		N						
1				M	M	M		M
2	2.0		2.0	25.0	3.5	14.3		3.7
3	1.5		1.5	17.0	10.0	13.5		4.5
4	10.0		10.0	20.5	5.0	12.8		5.2
5				11.0	4.5	7.8		10.2
6				14.0	-2.0	6.0		12.0
7				19.0	-1.5	8.8		9.2
8	10.2		10.2	18.5	3.5	11.0		7.0
9	6.7		6.7	10.0	7.0	8.5		9.5
10	T		T	17.0	7.5	12.3		5.7
11				15.0	6.0	10.5		7.5
12	T		T	7.0	1.5	4.3		13.7
13	M		M	M	M	M		M
14	11.2		11.2	7.0	M	M		M
15	1.2		1.2	9.0	2.0	5.5		12.5
16	T		T	15.0	4.0	9.5		8.5
17	17.8		17.8	7.5	5.5	6.5		11.5
18	10.1		10.1	7.5	4.0	5.8		12.2
19	7.6		7.6	7.5	4.0	5.8		12.2
20	4.1		4.1	M	M	M		M
21				13.0	M	M		M
22				17.5	0.0	8.8		9.2
23				19.0	1.0	10.0		8.0
24	91.0		91.0	21.0	1.0	11.0		7.0
25	42.4		42.4	9.0	8.0	8.5		9.5
26	3.2		3.2	12.0	3.5	6.3		11.7
27				14.5	-1.5	6.5		11.5
28	T		T	13.5	-1.0	6.3		11.7
29				14.5	-1.0	6.8		11.2
30	0.6		0.6	12.5	0.0	6.3		11.7
31								
∴		0						

MONTHLY SUMMARY / SOMMAIRE MENSUEL

PRECIPITATION(S)

	TOTAL	% OF/DE LA NORMALE:	EXTREME(S)
R/P	M		91.0
S/N	0.0	0	
P	M		91.0

TEMPERATURE

	MEAN °C MOY	FROM/DE LA NORMALE	EXTREME(S)
MAX	13.9	-6.1	25.0
MIN	2.9	0.9	-2.0
MN	8.4	-2.6	

SUNSHINE/INSOLATION DEG-DAYS/DEG-JOURS <18° C

	TOTAL	% POSSIBLE	% OF DE LA NORMALE
SUN/INSOL			
DEG-DYS/JRS	M		

SYNOPTICS/SYNOPTIQUES

MEAN/MOYENNE

HOUR HEURE	PRESSURE PRESSION kPa STATION	PRESSURE PRESSION kPa SEA LEVEL NIVEAU DE LA MER	TEMPERATURE °C	DEW POINT POINT DE ROSÉE °C	VAPOUR PRESSURE TENSION DE VAPEUR kPa

NUMBER OF OBSERVATIONS / NOMBRE D'OBSERVATIONS

CLOUD AMOUNT NÉBULOSITÉ TENTHS/ DIXIÈMES 0-2	3-7	8-10	VISIBILITY km VISIBILITÉ <1	1-10	>10

NUMBER OF DAYS WITH/NOMBRE DE JOURS AVEC

TEMPERATURES ≤ 0°C	7
RAIN OR DRIZZLE/PLUIE OU BRUINE	M
MEASURABLE PRECIPITATION/PRÉCIPITATIONS MESURABLES	M
SNOW/NEIGE	
THUNDERSTORMS/ORAGES	1
FREEZING PRECIPITATION/PRÉCIPITATIONS SE CONGELANT	U
HAIL/GRÊLE	U
FOG/BROUILLARD	U
SMOKE OR HAZE/FUMÉE OU BRUME SÈCHE	U
DUST OR BLOWING SAND/POUSSIÈRE OU CHASSE-SABLE ÉLEVÉE	U
BLOWING SNOW/CHASSE-NEIGE ÉLEVÉE	U

WIND/VENT

	DIRECTION	SPEED VITESSE km/h	DATE	PERCENTAGE FREQ. BY SPEED CLASS FREQ. DE LA CLASSE DE VITESSE EN POURCENTAGE km/h 0	1 -5	6 -11	12 -19	20 -28	29 -38	39 -49	50 -61	>61
PREVAILING/DOMINANT													
MAXIMUM													
PEAK/POINTE													

MEAN SPEED IN km/h - PERCENTAGE FREQUENCY BY DIRECTION
VITESSE MOYENNE EN km/h - FRÉQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW

TOTAL HOURS TOTAL DES HEURES

RECORDING RAIN GAUGE DATA/DONNÉES DES PLUVIOGRAPHES

DURATION/DURÉES	MAXIMUM AMOUNT (mm)/HAUTEUR MAXIMUM (mm) 5 min	10 min	15 min	30 min	60 min	120 min	6 h	12 h	24 h	HOURS OF RAINFALL - mm CLASSES HEURES DE PLUIE FREQ. PAR CLASSE mm 0.2 -2.9	3.0 -4.9	5.0 -12.9	13.0 -24.9	25.0 -49.9	50.0 +
AMOUNT/HAUTEUR															
DATE(S)															

EVAPORATION

WATER LOSS mm PERTE D'EAU	DAILY MEAN/MOYENNE QUOTIDIENNE TOTAL WIND RUN PARCOURS DU VENT km	TEMPERATURE °C WATER DE L'EAU	TEMPERATURE °C AIR DE L'AIR	LAKE EVAPORATION mm EVAPORATION DU LAC

EXPLANATION OF CODES/EXPLICATION DES CODES

R/P - RAINFALL/PLUIE
S/N - SNOWFALL/NEIGE
P - PRECIPITATION(S)
N - SNOW GAUGE/NIVOMÈTRE
∴ - SNOW ON GROUND/NEIGE AU SOL (cm)
T - LESS THAN 0.5%/INFÉRIEURE À 0.5%
+ - FIRST OF SEVERAL/PREMIER DE PLUSIEURS
M - MISSING/MANQUANTE
SVL - SEVERAL/PLUSIEURS
U - NOT OBSERVED/NON OBSERVÉ
- DATA MISSING FOR ONE OR MORE DAYS/VALEURS MANQUANTES POUR UN OU PLUSIEURS JOURS
P (SUNSHINE/INSOLATION) - POLAR NIGHT/LA NUIT POLAIRE
E ESTIMATE/ESTIMATIVE
T TRACE/S

A2

MONTHLY RECORD / RÉSUMÉ MENSUEL

SEP 1986 SEPT | 4021996 | CYPRESS HILLS | SASK / SASK | REF. C07.G04

LAT 49 ° 40 ' N LONG 109 ° 28 ' W ALT 1196 m

DAILY CLIMATE DATA/DONNÉES CLIMATIQUES QUOTIDIENNES

DATE	PRECIPITATION(S) R/P mm	S/N cm	P mm	TEMPERATURE °C MAX	MIN	MN	SUNSHINE INSOLATION h	DEGREE-DAYS DEGRÉ-JOURS <18°C
1				19.0	8.0	13.5		4.5
2	2.0		2.0	22.0	5.0	13.5		4.5
3	0.6		0.6	14.5	8.5	11.5		6.5
4	12.8		12.8	15.0	0.0	7.5		10.5
5	1.0		1.0	8.0	2.5	5.3		12.7
6				11.0	-3.0	4.0		14.0
7				14.0	-3.0	5.5		12.5
8	5.4		5.4	15.0	-1.0	7.0		11.0
9	13.8		13.8	9.0	6.5	7.8		10.2
10	T		T	13.0	7.0	10.0		8.0
11	6.5	0.5	7.0	12.0	5.0	8.5		9.5
12				3.5	0.0	1.8		16.2
13	4.0	1.0	5.0	3.5	0.0	1.8		16.2
14	6.6		6.6	5.5	0.0	2.8		15.2
15	2.6		2.6	6.0	2.5	4.3		13.7
16	T		T	13.5	5.0	9.3		8.7
17	17.0		17.0	6.0	4.0	5.0		13.0
18	15.6		15.6	5.5	3.0	4.3		13.7
19	5.4		5.4	5.0	3.0	4.0		14.0
20	4.6		4.6	5.5	3.0	4.3		13.7
21	T		T	8.5	3.5	6.0		12.0
22				17.0	-1.0	8.0		10.0
23				16.0	-1.5	7.3		10.7
24	68.0		68.0	18.5	0.0	9.3		8.7
25	36.0	2.6	38.6	7.0	3.0	5.0		13.0
26	4.4		4.4	9.0	3.0	4.5		13.5
27				12.5	-1.0	5.8		12.2
28				10.0	-2.0	4.0		14.0
29				13.0	-2.5	5.3		12.7
30				12.0	-1.5	5.3		12.7
31								
∴		0						

MONTHLY SUMMARY / SOMMAIRE MENSUEL

PRECIPITATION(S)

	TOTAL	% OF/DE LA NORMAL(E)	EXTREME(S)
R/P	206.3		68.0
S/N	4.1		2.6
P	210.4		68.0

TEMPERATURE

	MEAN °C FROM/DE LA MOY	NORMAL(E)	EXTREME(S)
MAX	11.0		22.0
MIN	1.8		-3.0
MN	6.4		

SUNSHINE/INSOLATION DEG-DAYS/DEG-JOURS <18° C

	TOTAL	% POSSIBLE	% OF/DE LA NORMAL(E)
SUN/INSOL			
DEG-DYS/JRS	347.8		

SYNOPTICS/SYNOPTIQUES

MEAN/MOYENNE

HOUR HEURE	PRESSURE PRESSION kPa STATION	PRESSURE PRESSION kPa SEA LEVEL NIVEAU DE LA MER	TEMPERATURE °C	DEW POINT POINT DE ROSÉE °C	VAPOUR PRESSURE TENSION DE VAPEUR kPa

NUMBER OF OBSERVATIONS / NOMBRE D'OBSERVATIONS

CLOUD AMOUNT NÉBULOSITÉ TENTHS/ DIXIÈMES 0-2	3-7	8-10	VISIBILITY km VISIBILITÉ <1	1-10	>10

NUMBER OF DAYS WITH/NOMBRE DE JOURS AVEC

TEMPERATURES ≤ 0°C	15
RAIN OR DRIZZLE/PLUIE OU BRUINE	17
MEASURABLE PRECIPITATION/PRÉCIPITATIONS MESURABLES	17
SNOW/NEIGE	3
THUNDERSTORMS/ORAGES	
FREEZING PRECIPITATION/PRÉCIPITATIONS SE CONGÉLANT	U
HAIL/GRÊLE	U
FOG/BROUILLARD	U
SMOKE OR HAZE/FUMÉE OU BRUME SÈCHE	U
DUST OR BLOWING SAND/POUSSIÈRE OU CHASSE-SABLE ÉLEVÉE	U
BLOWING SNOW/CHASSE-NEIGE ÉLEVÉE	U

WIND/VENT

	DIRECTION	SPEED VITESSE km/h	DATE	PERCENTAGE FREQ. BY SPEED CLASS FREQ. DE LA CLASSE DE VITESSE EN POURCENTAGE km/h 0	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
PREVAILING/ DOMINANT												
MAXIMUM												
PEAK/POINTE												

MEAN SPEED IN km/h - PERCENTAGE FREQUENCY BY DIRECTION
VITESSE MOYENNE EN km/h - FRÉQUENCE DE LA DIRECTION EN POURCENTAGE

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW

TOTAL HOURS TOTAL DES HEURES

RECORDING RAIN GAUGE DATA/DONNÉES DES PLUVIOGRAPHES

DURATION/DURÉES	MAXIMUM AMOUNT (mm)/HAUTEUR MAXIMUM (mm) 5 min	10 min	15 min	30 min	60 min	120 min	6 h	12 h	24 h
AMOUNT/HAUTEUR									
DATE(S)									

HOURS OF RAINFALL - mm CLASSES / HEURES DE PLUIE FRÉQ. PAR CLASSE mm

0.2 - 2.9	3.0 - 4.9	5.0 - 12.9	13.0 - 24.9	25.0 - 49.9	50.0 +

EVAPORATION

WATER LOSS mm PERTE D'EAU	DAILY MEAN/MOYENNE QUOTIDIENNE TOTAL WIND RUN PARCOURS DU VENT km	TEMPERATURE °C WATER DE L'EAU	TEMPERATURE °C AIR DE L'AIR	LAKE EVAPORATION mm EVAPORATION DU LAC

EXPLANATION OF CODES/EXPLICATION DES CODES

R/P - RAINFALL/PLUIE
S/N - SNOWFALL/NEIGE
P - PRECIPITATION(S)
N - SNOW GAUGE/NIVOMÈTRE
∴ - SNOW ON GROUND/NEIGE AU SOL (cm)
* - LESS THAN 0.5%/INFÉRIEURE À 0.5%
\+ - FIRST OF SEVERAL/PREMIER DE PLUSIEURS
M - MISSING/MANQUANTE
SVL - SEVERAL/PLUSIEURS
U - NOT OBSERVED/NON OBSERVÉ
E - ESTIMATE/ESTIMATIVE
T - TRACE(S)
0 - DATA MISSING FOR ONE OR MORE DAYS/VALEURS MANQUANTES POUR UN OU PLUSIEURS JOURS
P (SUNSHINE/INSOLATION) - POLAR NIGHT/LA NUIT POLAIRE

A3

MONTHLY RECORD / RÉSUMÉ MENSUEL

SEP 1986 SEPT | 4032323 EASTEND 2 | SASK / SASK | REF. 007.805

LAT 49 ° 31 'N LONG 108 ° 49 'W ALT 914 m

DAILY CLIMATE DATA/DONNÉES CLIMATIQUES QUOTIDIENNES

DATE	PRECIPITATION(S) R/P mm	S/N cm	P mm	TEMPERATURE °C MAX	MIN	MN	SUNSHINE INSOLATION h	DEGREE-DAYS DEGRÉ-JOURS <18°C
1				21.5	10.0	15.8		2.2
2	2.0		2.0	25.0	5.0	15.0		3.0
3				16.5	11.0	13.8		4.2
4	6.8		6.8	20.0	3.0	11.5		6.5
5				11.0	5.0	8.0		10.0
6				14.5	2.0	8.3		9.7
7				17.5	-3.5	7.0		11.0
8	2.2		2.2	19.0	1.5	10.3		7.7
9	4.0		4.0	10.0	9.0	9.5		8.5
10				17.0	8.5	12.8		5.2
11				14.5	5.0	9.8		8.2
12				5.5	2.0	3.8		14.2
13	8.0		8.0	5.0	1.0	3.0		15.0
14	5.0		5.0	7.0	3.0	5.0		13.0
15	2.0		2.0	7.0	4.0	5.5		12.5
16				14.0	5.0	9.5		8.5
17	2.2		2.2	8.0	5.0	6.5		11.5
18	2.2		2.2	7.0	5.0	6.0		12.0
19	18.0		18.0	8.5	5.0	6.8		11.2
20	1.0		1.0	8.0	5.0	6.5		11.5
21				12.0	5.5	8.8		9.2
22				19.0	3.0	11.0		7.0
23				19.5	3.5	11.5		6.5
24	50.8		50.8	22.0	0.0	11.0		7.0
25	11.9		11.9	9.5	7.5	8.5		9.5
26	11.9		11.9	11.5	1.5	6.5		11.5
27				14.5	-2.0	6.3		11.7
28				13.0	1.5	7.3		10.7
29				14.0	0.0	7.0		11.0
30				15.0	3.0	9.0		9.0
31								
∴		0						

MONTHLY SUMMARY / SOMMAIRE MENSUEL

PRECIPITATION(S)

	TOTAL	% OF/DE LA NORMAL(E)	EXTREME(S)
R/P	128.0		50.8
S/N	0.0		
P	128.0		50.8

TEMPERATURE

	MEAN °C	FROM/DE LA MOY NORMAL(E)	EXTREMES
MAX	13.6E		25.0
MIN	3.8		-3.5
MN	8.7E		

SUNSHINE/INSOLATION DEG-DAYS/DEG-JOURS <18° C

	TOTAL	% POSSIBLE	% OF/DE LA NORMAL(E)
SUN/INSOL			
DEG-DAYS/JRS	278.7		

SYNOPTICS/SYNOPTIQUES

MEAN/MOYENNE

HOUR HEURE	PRESSURE PRESSION kPa STATION	PRESSURE PRESSION kPa SEA LEVEL NIVEAU DE LA MER	TEMPERATURE °C	DEW POINT POINT DE ROSÉE °C	VAPOUR PRESSURE TENSION DE VAPEUR kPa

NUMBER OF OBSERVATIONS / NOMBRE D'OBSERVATIONS

CLOUD AMOUNT NÉBULOSITÉ TENTHS/ DIXIÈMES 0-2	3-7	8-10	VISIBILITY km VISIBILITÉ <1	1-10	>10

NUMBER OF DAYS WITH/NOMBRE DE JOURS AVEC

TEMPERATURES ≤ 0°C	4
RAIN OR DRIZZLE/PLUIE OU BRUINE	14
MEASURABLE PRECIPITATION/PRÉCIPITATIONS MESURABLES	14
SNOW/NEIGE	
THUNDERSTORMS/ORAGES	2
FREEZING PRECIPITATION/PRÉCIPITATIONS SE CONGELANT	U
HAIL/GRÊLE	U
FOG/BROUILLARD	U
SMOKE OR HAZE/FUMÉE OU BRUME SÈCHE	U
DUST OR BLOWING SAND/POUSSIÈRE OU CHASSE-SABLE ELEVÉE	U
BLOWING SNOW/CHASSE-NEIGE ELEVÉE	U

WIND/VENT

	DIRECTION	SPEED VITESSE km/h	DATE	PERCENTAGE FREQ. BY SPEED CLASS FRÉQ. DE LA CLASSE DE VITESSE EN POURCENTAGE km/h 0	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
PREVAILING/DOMINANT												
MAXIMUM												
PEAK/POINTE												

MEAN SPEED IN km/h - PERCENTAGE FREQUENCY BY DIRECTION
VITESSE MOYENNE EN km/h - FRÉQUENCE DE LA DIRECTION EN POURCENTAGE

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
TOTAL HOURS / TOTAL DES HEURES																

RECORDING RAIN GAUGE DATA/DONNÉES DES PLUVIOGRAPHES

DURATION/DURÉES	5 min	10 min	15 min	30 min	60 min	120 min	6 h	12 h	24 h
AMOUNT/HAUTEUR									
DATE(S)									

HOURS OF RAINFALL - mm CLASSES / HEURES DE PLUIE FRÉQ. PAR CLASSE mm

0.2-2.9	3.0-4.9	5.0-12.9	13.0-24.9	25.0-49.9	50.0 +

EVAPORATION

WATER LOSS mm PERTE D'EAU	DAILY MEAN/MOYENNE QUOTIDIENNE TOTAL WIND RUN PARCOURS DU VENT km	TEMPERATURE °C WATER DE L'EAU	TEMPERATURE °C AIR DE L'AIR	LAKE EVAPORATION mm EVAPORATION DU LAC

EXPLANATION OF CODES/EXPLICATION DES CODES

R/P - RAINFALL/PLUIE
S/N - SNOWFALL/NEIGE
P - PRECIPITATION(S)
N - SNOW GAUGE/NIVOMÈTRE
∴ - SNOW ON GROUND/NEIGE AU SOL (cm)
• - LESS THAN 0.5%/INFÉRIEURE À 0.5%
+ - FIRST OF SEVERAL/PREMIER DE PLUSIEURS
M - MISSING/MANQUANTE
SVL - SEVERAL/PLUSIEURS
U - NOT OBSERVED/NON OBSERVÉ
0 - DATA MISSING FOR ONE OR MORE DAYS/VALEURS MANQUANTES POUR UN OU PLUSIEURS JOURS
P (SUNSHINE/INSOLATION) - POLAR NIGHT/LA NUIT POLAIRE
E - ESTIMATE/ESTIMATIVE
T - TRACE(S)

A4

MONTHLY RECORD / RÉSUMÉ MENSUEL

SEP 1986 SEPT | 3044200 MANYBERRIES CDA | ALTA / ALB | REF. 005.C15

LAT 49 ° 07 'N LONG 110 ° 28 'W ALT 934 m

DAILY CLIMATE DATA/DONNÉES CLIMATIQUES QUOTIDIENNES

DATE	PRECIPITATION(S) R/P mm	S/N cm	P mm	TEMPERATURE °C MAX	MIN	MN	SUNSHINE INSOLATION h	DEGREE-DAYS DEGRÉ-JOURS <18°C
		N						
1				23.0	11.0	17.0	:0.6	1.0
2				27.0	8.0	17.5	8.3	.5
3	1.4		1.4	18.0	11.0	14.5	7.7	3.5
4	8.2		8.2	22.0	8.0	15.0	8.5	3.0
5	2.6		2.6	11.5	5.0	8.3	1.4	9.7
6				14.0	1.0	7.5	12.2	10.5
7				18.0	1.0	9.5	12.0	8.5
8	7.8		7.8	15.0	4.0	9.5	.2	8.5
9	10.2		10.2	12.0	8.0	10.0	.0	8.0
10	2.1		2.1	20.0	7.0	13.5	6.7	4.5
11	0.6		0.6	14.0	7.0	10.5	8.6	7.5
12	1.0		1.0	8.0	2.0	5.0	.3	13.0
13	5.4		5.4	8.0	3.0	5.5	.0	12.5
14	2.8		2.8	9.0	3.0	6.0	.0	12.0
15	2.4		2.4	10.0	4.0	7.0	.0	11.0
16	4.0		4.0	16.0	5.0	10.5	6.3	7.5
17	5.4	N	5.4	10.0	8.0	9.0	.0	9.0
18	15.6		15.6	7.0	6.0	6.5	.0	11.5
19	7.0		7.0	8.5	5.0	6.8	.7	11.2
20	7.6		7.6	7.5	4.0	5.8	.0	12.2
21				14.0	3.0	8.5	5.5	9.5
22				19.0	5.0	12.0	11.0	6.0
23				21.0	3.0	12.0	10.8	6.0
24	62.5		62.5	18.0	4.0	11.0	4.2	7.0
25	32.4		32.4	8.0	8.0	8.0	.0	10.0
26				14.5	1.0	7.8	4.2	10.2
27				15.0	0.0	7.5	9.5	10.5
28				13.0	1.0	7.0	4.5	11.0
29				15.0	1.0	8.0	9.1	10.0
30				14.0	2.0	8.0	2.0	13.0
31								
∴		0						

MONTHLY SUMMARY / SOMMAIRE MENSUEL

	PRECIPITATION(S) TOTAL	% OF/DE LA NORMAL(E)	EXTREME(S)
R/P	179.0	814	62.5
S/N	0.0	0	
P	179.0	762	62.5

	TEMPERATURE MEAN °C MOY	FROM/DE LA NORMALE	EXTREME(S)
MAX	14.3	-5.4	27.0
MIN	4.6	-0.6	0.0
MN	9.5	-2.9	

	SUNSHINE/INSOLATION DEG-DAYS/DEG-JOURS <18° C TOTAL	% POSSIBLE	% OF/DE LA NORMALE
SUN/INSOL	144.3	38	66
DEG-DYS/JRS	255.3		147

SYNOPTICS/SYNOPTIQUES

MEAN/MOYENNE

HOUR / HEURE	PRESSURE / PRESSION kPa STATION	SEA LEVEL / NIVEAU DE LA MER	TEMPERATURE °C	DEW POINT / POINT DE ROSÉE °C	VAPOUR PRESSURE / TENSION DE VAPEUR kPa

NUMBER OF OBSERVATIONS / NOMBRE D'OBSERVATIONS

CLOUD AMOUNT / NÉBULOSITÉ TENTHS/ DIXIÈMES 0-2	3-7	8-10	VISIBILITY km / VISIBILITÉ <1	1-10	>10

NUMBER OF DAYS WITH / NOMBRE DE JOURS AVEC

TEMPERATURES ≤ 0°C	1
RAIN OR DRIZZLE/PLUIE OU BRUINE	18
MEASURABLE PRECIPITATION/PRÉCIPITATIONS MESURABLES	18
SNOW/NEIGE	
THUNDERSTORMS/ORAGES	
FREEZING PRECIPITATION/PRÉCIPITATIONS SE CONGELANT	
HAIL/GRÊLE	
FOG/BROUILLARD	U
SMOKE OR HAZE/FUMÉE OU BRUME SÈCHE	U
DUST OR BLOWING SAND/POUSSIÈRE OU CHASSE-SABLE ELEVÉE	U
BLOWING SNOW/CHASSE-NEIGE ELEVÉE	U

WIND/VENT

	DIRECTION	SPEED / VITESSE km/h	DATE	PERCENTAGE FREQ. BY SPEED CLASS / FREQ. DE LA CLASSE DE VITESSE EN POURCENTAGE km/h 0	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
PREVAILING/DOMINANT												
MAXIMUM												
PEAK/POINTE												

MEAN SPEED IN km/h - PERCENTAGE FREQUENCY BY DIRECTION / VITESSE MOYENNE EN km/h - FRÉQUENCE DE LA DIRECTION EN POURCENTAGE

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW

TOTAL HOURS / TOTAL DES HEURES

RECORDING RAIN GAUGE DATA/DONNÉES DES PLUVIOGRAPHES

DURATION/DURÉES	MAXIMUM AMOUNT (mm)/HAUTEUR MAXIMUM (mm) 5 mn	10 mn	15 mn	30 mn	60 mn	120 mn	6 h	12 h	24 h	HOURS OF RAINFALL - mm CLASSES / HEURES DE PLUIE FRÉQ. PAR CLASSE mm 0.2-.9	1.0-4.9	5.0-12.9	13.0-24.9	25.0-49.9	50.0 +
AMOUNT/HAUTEUR	M	M	M	M	M	M	M	M	M	M	M	M	M	M	
DATE(S) #															

EVAPORATION

WATER LOSS mm / PERTE D'EAU	DAILY MEAN/MOYENNE QUOTIDIENNE TOTAL WIND RUN / PARCOURS DU VENT km	TEMPERATURE °C WATER / DE L'EAU	AIR / DE L'AIR	LAKE EVAPORATION mm / EVAPORATION DU LAC
92.4	143	10.5	9.4	68.6

EXPLANATION OF CODES/EXPLICATION DES CODES

R/P - RAINFALL/PLUIE
S/N - SNOWFALL/NEIGE
P - PRECIPITATION(S)
N - SNOW GAUGE/NIVOMÈTRE
- DATA MISSING FOR ONE OR MORE DAYS/VALEURS MANQUANTES POUR UN OU PLUSIEURS JOURS
∴ - SNOW ON GROUND/NEIGE AU SOL (cm)
• - LESS THAN 0.5%/INFÉRIEURE À 0.5%
+ - FIRST OF SEVERAL/PREMIER DE PLUSIEURS
M - MISSING/MANQUANTE
P (SUNSHINE/INSOLATION) - POLAR NIGHT/LA NUIT POLAIRE
SVL - SEVERAL/PLUSIEURS
U - NOT OBSERVED/NON OBSERVÉ
E - ESTIMATE/ESTIMATIVE
T - TRACE(S)

A5

MONTHLY RECORD / RÉSUMÉ MENSUEL

SEP 1986 SEPT | 4024936 MAPLE CREEK NORTH | SASK / SASK | REF. 007.009

LAT 50 ° 00 'N LONG 109 ° 28 'W ALT 764 m

DAILY CLIMATE DATA/DONNÉES CLIMATIQUES QUOTIDIENNES

DATE	PRECIPITATION(S) R/P mm	S/N cm	P mm	TEMPERATURE °C MAX	MIN	MN	SUNSHINE INSOLATION h	DEGREE-DAYS DEGRÉ-JOURS <18°C
1				25.0	10.0	17.5		.5
2	0.8		0.8	25.5	11.0	18.3		
3				19.5	9.5	14.5		3.5
4	19.6		19.6	17.0	4.0	10.5		7.5
5	0.8		0.8	12.0	6.0	9.0		9.0
6				15.0	1.0	8.0		10.0
7				19.0	2.0	10.5		7.5
8	1.2		1.2	22.0	6.0	14.0		4.0
9	6.1		6.1	14.0	8.0	11.0		7.0
10	0.4		0.4	19.0	8.5	13.8		4.2
11	1.6		1.6	15.0	8.0	11.5		6.5
12	1.8		1.8	7.0	3.0	5.0		13.0
13	7.4		7.4	7.0	3.0	5.0		13.0
14	3.7		3.7	8.5	3.0	5.8		12.2
15	3.6		3.6	9.0	3.0	6.0		12.0
16	0.3		0.3	15.0	6.5	10.8		7.2
17	5.8		5.8	8.5	5.0	6.8		11.2
18	6.8		6.8	10.0	5.0	7.5		10.5
19	4.9		4.9	8.0	5.5	6.8		11.2
20	6.8		6.8	10.0	5.0	7.5		10.5
21	0.4		0.4	13.0	6.5	9.8		8.2
22				18.0	3.0	10.5		7.5
23				21.0	7.0	14.0		4.0
24	48.8		48.8	23.0	4.0	13.5		4.5
25	38.8		38.8	9.0	5.0	7.0		11.0
26	2.7		2.7	10.0	2.0	6.0		12.0
27	0.4		0.4	17.0	1.0	9.0		9.0
28				13.0	2.0	7.5		10.5
29				16.0	2.5	9.3		8.7
30	0.2		0.2	14.0	2.0	8.0		10.0
31								
∴		0						

MONTHLY SUMMARY / SOMMAIRE MENSUEL

	PRECIPITATION(S) TOTAL	% OF/DE LA NORMALE(I)	EXTREME(S)
R/P	162.9	485	48.8
S/N	0.0	0	
P	162.9	455	48.8

	TEMPERATURE MEAN °C MOY	FROM/DE LA NORMALE(I)	EXTREME(S)
MAX	14.7	-5.6	25.5
MIN	4.9	-1.0	1.0
MN	9.8	-3.3	

	SUNSHINE/INSOLATION DEG-DAYS/DEG-JOURS <18° C TOTAL	% POSSIBLE	% OF/DE LA NORMALE(I)
SUN/INSOL			
DEG-DYS/JRS	245.9		153

SYNOPTICS/SYNOPTIQUES

HOUR HEURE	MEAN/MOYENNE PRESSURE PRESSION kPa STATION	PRESSURE PRESSION kPa SEA LEVEL NIVEAU DE LA MER	TEMPERATURE °C	DEW POINT POINT DE ROSÉE °C	VAPOUR PRESSURE TENSION DE VAPEUR kPa	NUMBER OF OBSERVATIONS NOMBRE D'OBSERVATIONS CLOUD AMOUNT NÉBULOSITÉ TENTHS/ DIXIÈMES 0-2	3-7	8-10	VISIBILITY km VISIBILITÉ <1	1-10	>10

NUMBER OF DAYS WITH/NOMBRE DE JOURS AVEC

TEMPERATURES ≤ 0°C	22
RAIN OR DRIZZLE/PLUIE OU BRUINE	22
MEASURABLE PRECIPITATION/PRÉCIPITATIONS MESURABLES	
SNOW/NEIGE	
THUNDERSTORMS/ORAGES	U
FREEZING PRECIPITATION/PRÉCIPITATIONS SE CONGÉLANT	U
HAIL/GRÊLE	U
FOG/BROUILLARD	U
SMOKE OR HAZE/FUMÉE OU BRUME SÈCHE	U
DUST OR BLOWING SAND/POUSSIÈRE OU CHASSE-SABLE ÉLEVÉE	U
BLOWING SNOW/CHASSE-NEIGE ÉLEVÉE	U

WIND/VENT

	DIRECTION	SPEED VITESSE km/h	DATE	PERCENTAGE FREQ. BY SPEED CLASS FRÉQ. PE LA CLASSE DE VITESSE EN POURCENTAGE km/h 0	1 -5	6 -11	12 -19	20 -28	29 -38	39 -49	50 -61	>61	MEAN SPEED IN km/h - PERCENTAGE FREQUENCY BY DIRECTION VITESSE MOYENNE EN km/h - FRÉQUENCE DE LA DIRECTION EN POURCENTAGE N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
PREVAILING/ DOMINANT																										
MAXIMUM																										
PEAK/POINTE																										

TOTAL HOURS / TOTAL DES HEURES

RECORDING RAIN GAUGE DATA/DONNÉES DES PLUVIOGRAPHES

MAXIMUM AMOUNT (mm)/HAUTEUR MAXIM'M (mm)

DURATION/DURÉES	5 min	10 min	15 min	30 min	60 min	120 min	6 h	12 h	24 h
AMOUNT/HAUTEUR									
DATE(S)									

HOURS OF RAINFALL - mm CLASSES HEURES DE PLUIE FRÉQ. PAR CLASSE mm

0.2 -2.9	3.0 -4.9	5.0 -12.9	13.0 -24.9	25.0 -49.9	50.0 +

EVAPORATION

WATER LOSS mm PERTE D'EAU	DAILY MEAN/MOYENNE QUOTIDIENNE TOTAL WIND RUN PARCOURS DU VENT km	TEMPERATURE °C WATER DE L'EAU	AIR DE L'AIR	LAKE EVAPORATION mm EVAPORATION DU LAC

EXPLANATION OF CODES/EXPLICATION DES CODES

R/P - RAINFALL/PLUIE
S/N - SNOWFALL/NEIGE
P - PRECIPITATION(S)
N - SNOW GAUGE/NIVOMÈTRE
∴ - SNOW ON GROUND/NEIGE AU SOL (cm)
. - LESS THAN 0.5%/INFÉRIEURE À 0.5%
+ - FIRST OF SEVERAL/PREMIER DE PLUSIEURS
M - MISSING/MANQUANTE
SVL - SEVERAL/PLUSIEURS
U - NOT OBSERVED/NON OBSERVÉ
E - ESTIMATE/ESTIMATIVE
T - TRACE(S)
0 - DATA MISSING FOR ONE OR MORE DAYS/VALEURS MANQUANTES POUR UN OU PLUSIEURS JOURS
P (SUNSHINE/INSOLATION) - POLAR NIGHT/LA NUIT POLAIRE

A6

MONTHLY RECORD / RÉSUMÉ MENSUEL

SEP 1986 SEPT — 3034480 MEDICINE HAT A — ALTA / ALB — REF. 005.115

LAT 50 ° 01 'N LONG 110 ° 43 'W AIT 722 m

DAILY CLIMATE DATA/DONNÉES CLIMATIQUES QUOTIDIENNES

DATE	PRECIPITATION(S) R/P mm	S/N cm	P mm	TEMPERATURE °C MAX	MIN	MN	SUNSHINE INSOLATION h	DEGREE-DAYS DEGRÉ-JOURS <18°C
		N						
1				24.3	8.2	16.3	:0.1	1.7
2	0.4		0.4	27.0	11.9	19.5	9.4	
3	9.0		9.0	19.0	11.1	15.1	5.8	2.9
4	13.8		13.8	17.9	7.0	12.5	2.8	5.5
5	4.7		4.7	12.6	6.8	9.7	3.6	8.3
6				14.6	1.1	7.9	11.1	10.1
7				18.5	2.8	10.7	11.2	7.3
8	0.5		0.5	17.5	6.2	11.9	1.4	6.1
9	11.6		11.6	12.3	7.5	9.9	.0	8.1
10	T		T	19.7	8.2	14.0	8.0	4.0
11	T		T	13.8	5.3	9.6	6.2	8.4
12	2.9		2.9	9.2	3.2	6.2	.0	11.8
13	2.8		2.8	8.0	2.6	5.3	.0	12.7
14	0.2		0.2	8.2	2.4	5.3	.0	12.7
15	0.9		0.9	10.7	5.9	8.3	.0	9.7
16	T		T	14.4	4.5	9.5	1.8	8.5
17	7.8		7.8	9.2	7.1	8.2	.0	9.8
18	1.2		1.2	10.1	6.1	8.1	.0	9.9
19	16.4		16.4	8.4	5.6	7.0	.0	11.0
20	9.1		9.1	8.1	5.0	6.6	.0	11.4
21	T		T	14.3	5.7	10.0	5.2	8.0
22				19.6	4.0	11.8	5.8	6.2
23				20.9	4.9	12.9	8.3	5.1
24	10.1		10.1	19.5	0.6	10.1	5.5	7.9
25	96.6		96.6	10.6	3.7	7.2	.0	10.8
26	9.6		9.6	8.6	2.4	5.5	.0	12.5
27				15.8	0.4	8.1	8.5	9.9
28				13.7	2.7	8.2	6.7	9.8
29				15.1	1.4	8.3	9.7	9.7
30				13.3	4.9	9.1	3.2	8.9
31								
∴		0						

MONTHLY SUMMARY / SOMMAIRE MENSUEL

	PRECIPITATION(S) TOTAL	% OF/DE LA NORMAL(E)	EXTREME(S)
R/P	197.6	646	96.6
S/N	0.0	0	
P	197.6	610	96.6

	TEMPERATURE MEAN °C MOY.	FROM/DE LA NORMAL(E)	EXTREME(S)
MAX	14.5	-5.9	27.0
MIN	5.0	-0.9	0.4
MN	9.8	-3.4	

	SUNSHINE/INSOLATION DEG-DAYS/DEG-JOURS <18° C TOTAL	% POSSIBLE	% OF/DE LA NORMAL(E)
SUN/INSOL	124.3	33	62
DEG-DYS/JRS	248.7		160

SYNOPTICS/SYNOPTIQUES

MEAN/MOYENNE

HOUR HEURE	PRESSURE PRESSION kPa STATION	SEA LEVEL NIVEAU DE LA MER	TEMPERATURE °C	DEW POINT POINT DE ROSÉE °C	VAPOUR PRESSURE TENSION DE VAPEUR kPa	NUMBER OF OBSERVATIONS NOMBRE D'OBSERVATIONS CLOUD AMOUNT NÉBULOSITÉ TENTHS/ DIXIÈMES 0-2	3-7	8-10	VISIBILITY km VISIBILITÉ <1	1-10	>10
05M	93.08	101.50	6.2	4.8	.88	4	6	20		4	26
11	93.10	101.53	11.3	5.3	.90	1	5	24		2	28
17	93.00	101.42	13.1	5.1	.89	2	5	23		1	29
23	93.07	101.50	8.3	5.5	.91	5	5	20			30

NUMBER OF DAYS WITH/NOMBRE DE JOURS AVEC

TEMPERATURES ≤ 0°C	
RAIN OR DRIZZLE/PLUIE OU BRUINE	17
MEASURABLE PRECIPITATION/PRÉCIPITATIONS MESURABLES	17
SNOW/NEIGE	
THUNDERSTORMS/ORAGES	1
FREEZING PRECIPITATION/PRÉCIPITATIONS SE CONGÉLANT	
HAIL/GRÊLE	
FOG/BROUILLARD	1
SMOKE OR HAZE/FUMÉE OU BRUME SÈCHE	
DUST OR BLOWING SAND/POUSSIÈRE OU CHASSE-SABLE ÉLEVÉE	
BLOWING SNOW/CHASSE-NEIGE ÉLEVÉE	

WIND/VENT

	DIRECTION	SPEED VITESSE km/h	DATE	PERCENTAGE FREQ. BY SPEED CLASS FRÉQ. DE LA CLASSE DE VITESSE EN POURCENTAGE km/h 0	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
PREVAILING/ DOMINANT	E	9.8			7		22		1			
MAXIMUM	NNE	43	02	17		44		9		•		
PEAK/POINTE	NNE	65	02									

MEAN SPEED IN km/h - PERCENTAGE FREQUENCY BY DIRECTION
VITESSE MOYENNE EN km/h - FRÉQUENCE DE LA DIRECTION EN POURCENTAGE

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
	12.5	12.4	12.8	10.0	9.8	7.6	8.3	7.3	16.0	13.7	11.9	12.8	11.3	15.7	14.4	12.9
	6	7	4	10	12	2	1	1	3	4	9	6	9	4	2	3

TOTAL HOURS 720 TOTAL DES HEURES

RECORDING RAIN GAUGE DATA/DONNÉES DES PLUVIOGRAPHES

DURATION/DURÉE	MAXIMUM AMOUNT (mm)/HAUTEUR MAXIMUM (mm) 5 min	10 min	15 min	30 min	60 min	120 min	6 h	12 h	24 h
AMOUNT/HAUTEUR	1.3	1.9	2.5	4.8	9.6	16.4	44.2	79.1	104.0
DATE(S)	24	24	24	24	24	24	24	25	25

HOURS OF RAINFALL - mm CLASSES
HEURES DE PLUIE FRÉQ. PAR CLASSE mm

0.2 -2.9	3.0 -4.9	5.0 -12.9	13.0 -24.9	25.0 -49.9	50.0 +
111	6	12			

EVAPORATION

WATER LOSS mm PERTE D'EAU	DAILY MEAN/MOYENNE QUOTIDIENNE TOTAL WIND RUN PARCOURS DU VENT km	TEMPERATURE °C WATER DE L'EAU	AIR DE L'AIR	LAKE EVAPORATION mm ÉVAPORATION DU LAC

EXPLANATION OF CODES/EXPLICATION DES CODES

R/P - RAINFALL/PLUIE
S/N - SNOWFALL/NEIGE
P - PRECIPITATION(S)
N - SNOW GAUGE/NIVOMÈTRE
∴ - SNOW ON GROUND/NEIGE AU SOL (cm)
• - LESS THAN 0.5/INFÉRIEURE À 0.5
0 - DATA MISSING FOR ONE OR MORE DAYS/VALEURS MANQUANTES POUR UN OU PLUSIEURS JOURS
+ - FIRST OF SEVERAL/PREMIER DE PLUSIEURS
M - MISSING/MANQUANTE
P (SUNSHINE/INSOLATION) - POLAR NIGHT/LA NUIT POLAIRE
SVL - SEVERAL/PLUSIEURS
U - NOT OBSERVED/NON OBSERVÉ
E - ESTIMATE/ESTIMATIVE
T - TRACE(S)

A7

I 15

MONTHLY RECORD / RÉSUMÉ MENSUEL

SEP 1986 SEPT | 4039001 WILLOW CREEK | SASK / SASK | REF. 007.J16

LAT 49 ° 00 'N LONG 109 ° 44 'W ALT 846 m

DAILY CLIMATE DATA/DONNÉES CLIMATIQUES QUOTIDIENNES

DATE	PRECIPITATION(S) R/P mm	S/N cm	P mm	TEMPERATURE °C MAX	MIN	MN	SUNSHINE INSOLATION h	DEGREE-DAYS DEGRÉ-JOURS <18°C
1				23.0	11.0	17.0		1.0
2	1.8		1.8	26.0	6.5	16.3		1.7
3	T		T	18.0	11.0	14.5		3.5
4	7.4		7.4	22.0	6.0	14.0		4.0
5				10.0	5.0	7.5		10.5
6				15.0	-0.5	7.3		10.7
7				19.0	-1.0	9.0		9.0
8	16.0		16.0	17.0	5.0	11.0		7.0
9	4.0		4.0	11.0	9.0	10.0		8.0
10	1.8		1.8	18.0	8.5	13.3		4.7
11				15.0	8.5	11.8		6.2
12	1.0		1.0	8.0	1.5	4.8		13.2
13	7.6		7.6	7.5	3.5	5.5		12.5
14	2.9		2.9	8.5	3.5	6.0		12.0
15	1.6		1.6	9.5	5.0	7.3		10.7
16	20.4		20.4	16.0	7.0	11.5		6.5
17	3.4		3.4	9.5	6.0	7.8		10.2
18	13.0		13.0	7.5	5.5	6.5		11.5
19	4.4		4.4	9.0	5.0	7.0		11.0
20	4.0		4.0	8.0	5.0	6.5		11.5
21				14.0	2.0	8.0		10.0
22				19.0	3.0	11.0		7.0
23				20.0	2.5	11.3		6.7
24	106.0		106.0	20.0	0.5	10.3		7.7
25	35.6		35.6	9.0	6.0	7.5		10.5
26				15.0	2.0	8.5		9.5
27				15.5	1.0	8.3		9.7
28				12.0	2.0	7.0		11.0
29				15.0	1.0	8.0		10.0
30				14.5	4.0	9.3		8.7
31								
∴		0						

MONTHLY SUMMARY / SOMMAIRE MENSUEL

PRECIPITATION(S)

	TOTAL	% OF/DE LA NORMAL(E)	EXTREME(S)
R/P	230.9		106.0
S/N	0.0		
P	230.9		106.0

TEMPERATURE

	MEAN °C MOY	FROM/DE LA NORMALE:	EXTREME(S)
MAX	14.4		26.0
MIN	4.5		-1.0
MN	9.5		

SUNSHINE/INSOLATION DEG-DAYS/DEG-JOURS <18° C

	TOTAL	% POSSIBLE	% OF/DE LA NORMALE
SUN/INSOL			
DEG-DYS/JRS	256.2		

SYNOPTICS/SYNOPTIQUES

MEAN/MOYENNE

HOUR HEURE	PRESSURE PRESSION hPa STATION	PRESSURE PRESSION hPa SEA LEVEL NIVEAU DE LA MER	TEMPERATURE °C	DEW POINT POINT DE ROSÉE °C	VAPOUR PRESSURE TENSION DE VAPEUR hPa

NUMBER OF OBSERVATIONS / NOMBRE D'OBSERVATIONS

CLOUD AMOUNT NÉBULOSITÉ TENTHS/ DIXIÈMES 0-2	3-7	8-10	VISIBILITY km VISIBILITÉ <1	1-10	>10

NUMBER OF DAYS WITH/NOMBRE DE JOURS AVEC

TEMPERATURES ≤ 0°C	2
RAIN OR DRIZZLE/PLUIE OU BRUINE	16
MEASURABLE PRECIPITATION/PRÉCIPITATIONS MESURABLES	16
SNOW/NEIGE	
THUNDERSTORMS/ORAGES	
FREEZING PRECIPITATION/PRÉCIPITATIONS SE CONGELANT	U
HAIL/GRÊLE	U
FOG/BROUILLARD	U
SMOKE OR HAZE/FUMÉE OU BRUME SÈCHE	U
DUST OR BLOWING SAND/POUSSIÈRE OU CHASSE-SABLE ÉLEVÉE	U
BLOWING SNOW/CHASSE-NEIGE ÉLEVÉE	U

WIND/VENT

	DIRECTION	SPEED VITESSE km/h	DATE	PERCENTAGE FREQ. BY SPEED CLASS FREQ. DE LA CLASSE DE VITESSE EN POURCENTAGE km/h: 0	1-5	6-11	12-19	20-28	29-38	39-49	50-61	>61
PREVAILING/DOMINANT												
MAXIMUM												
PEAK/POINTE												

MEAN SPEED IN km/h - PERCENTAGE FREQUENCY BY DIRECTION
VITESSE MOYENNE EN km/h - FRÉQUENCE DE LA DIRECTION EN POURCENTAGE

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
PREVAILING/DOMINANT																
MAXIMUM																
PEAK/POINTE																

TOTAL HOURS TOTAL DES HEURES

RECORDING RAIN GAUGE DATA/DONNÉES DES PLUVIOGRAPHES

DURATION/DURÉES	MAXIMUM AMOUNT (mm)/HAUTEUR MAXIMUM (mm) 5 min	10 min	15 min	30 min	60 min	120 min	6 h	12 h	24 h
AMOUNT/HAUTEUR									
DATE(S)									

HOURS OF RAINFALL - mm CLASSES / HEURES DE PLUIE FRÉQ. PAR CLASSE mm	0.2 - 2.9	3.0 - 4.9	5.0 - 12.9	13.0 - 24.9	25.0 - 49.9	50.0 +

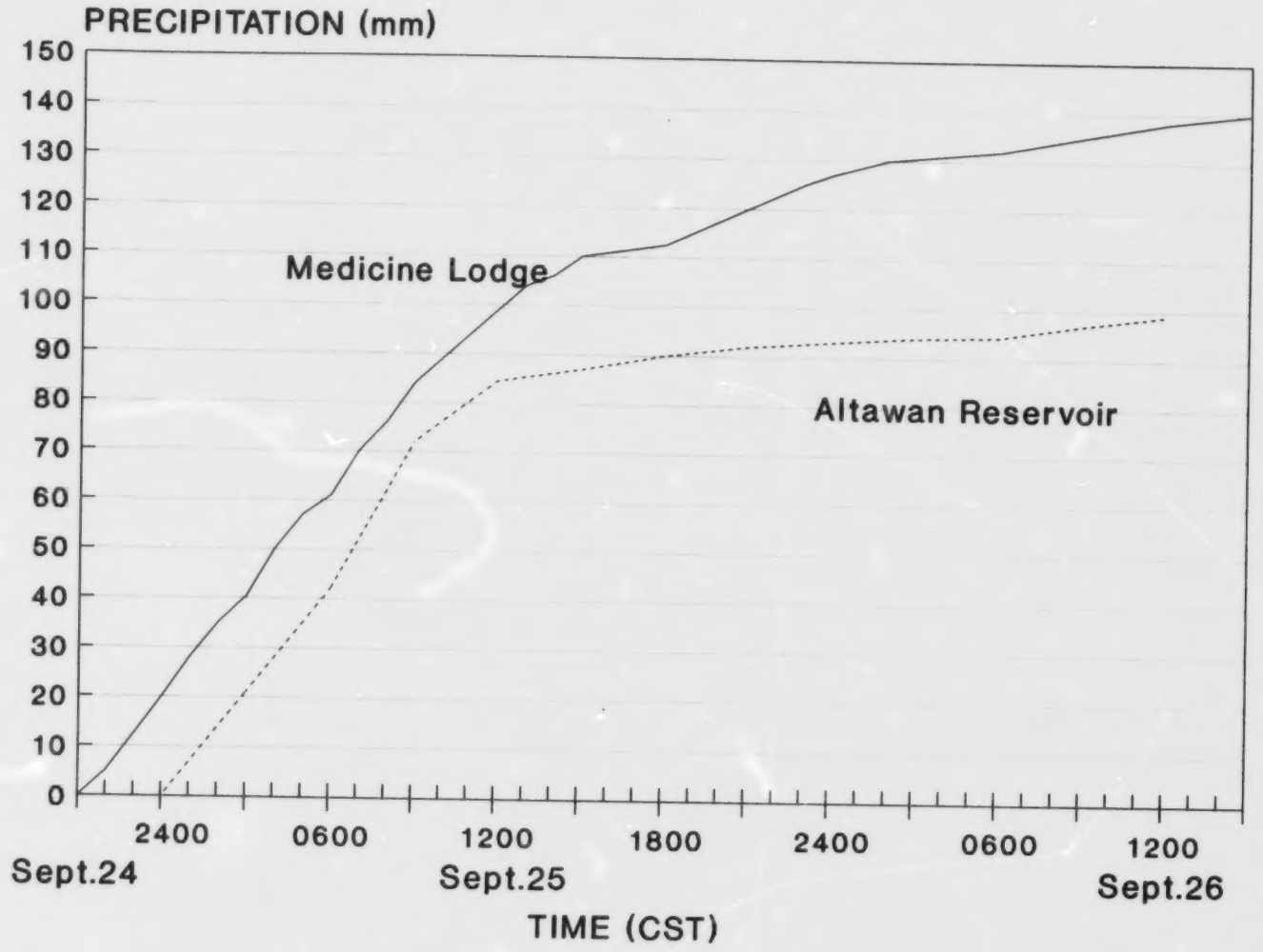
EVAPORATION

WATER LOSS mm PERTE D'EAU	DAILY MEAN/MOYENNE QUOTIDIENNE TOTAL WIND RUN PARCOURS DU VENT km	TEMPERATURE °C WATER DE L'EAU	TEMPERATURE °C AIR DE L'AIR	LAKE (EVAPORATION mm (EVAPORATION DU LAC

EXPLANATION OF CODES/EXPLICATION DES CODES

R/P - RAINFALL/PLUIE
S/N - SNOWFALL/NEIGE
P - PRECIPITATION(S)
N - SNOW GAUGE/NIVOMÈTRE
∴ - SNOW ON GROUND/NEIGE AU SOL (cm)
T - LESS THAN 0.5%/INFÉRIEURE À 0.5%
+ - FIRST OF SEVERAL/PREMIER DE PLUSIEURS
M - MISSING/MANQUANTE
SVL - SEVERAL/PLUSIEURS
U - NOT OBSERVED/NON OBSERVÉ
E - ESTIMATE/ESTIMATIVE
T - TRACE(S)
- DATA MISSING FOR ONE OR MORE DAYS/VALEURS MANQUANTES POUR UN OU PLUSIEURS JOURS
P (SUNSHINE/INSOLATION) - POLAR NIGHT/LA NUIT POLAIRE

PRECIPITATION MASS CURVES
September 24 - 26, 1986



APPENDIX B

HYDROMETRIC STATION DATA

Middle Creek Stations*

- Middle Creek near Saskatchewan Boundary (11AB009)
- Middle Creek below Middle Creek Reservoir (11AB001)
- Middle Creek near Govenlock (11AB108)
- Middle Creek above Lodge Creek (11AB008)

Lodge Creek Stations

- Lodge Creek near Alberta Boundary (11AB082)
- Squaw Coulee near Willow Creek (11AB103)
- Lodge Creek below McRae Creek at International Boundary (11AB083)

Battle Creek Stations

- Battle Creek at Alberta Boundary (11AB117)
- Cypress Lake West Inflow Canal (11AB078)
- Battle Creek below Wilson's Weir (11AB118)
- Cypress Lake West Outflow Canal (11AB077)
- Battle Creek near Consul (11AB096)
- Nashlyn Canal near Consul (11AB018)
- Battle Creek below Nashlyn Project (11AB101)
- Battle Creek at International Boundary (11AB027)

Lyons Creek Stations

- Lyons Creek at International Boundary (11AB075)

* Middle Creek is a major tributary to Lodge Creek

MIDDLE CREEK NEAR SASKATCHEWAN BOUNDARY
(11AB009)

LOCATION: LAT.49-25-29 N. LONG.110-03-09 W., SE1/4 Sec.34 Twp.5 Rge1 W4th Mer. approximately 16 km west and 23 km north of Govenlock, 2.5 km upstream of Middle Creek Reservoir.

DRAINAGE AREA: 305 km2

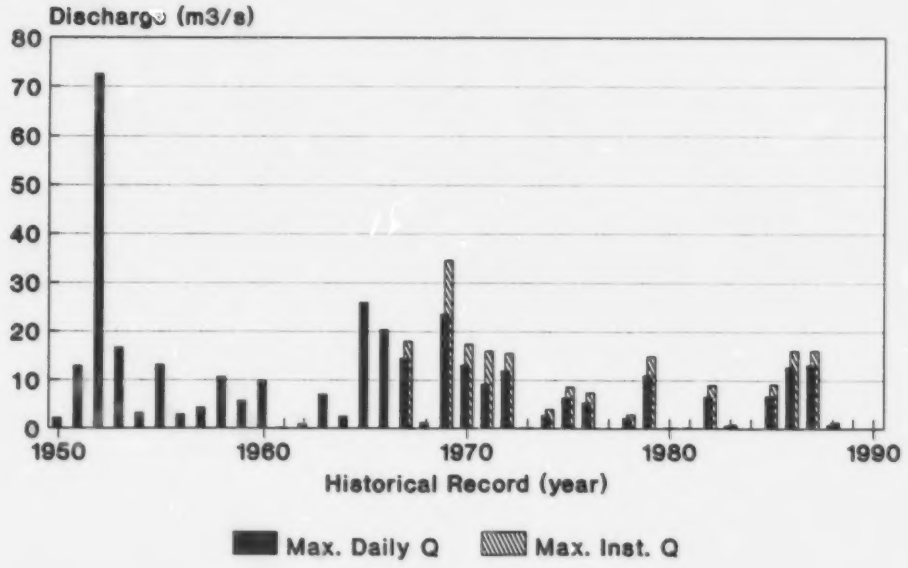
STAGE RECORD: Float activated recorder in standard shelter.

DISCHARGE RECORD: Stage-discharge relationship determined by wading measurements at low stage and bridge measurement (457 m downstream of the control section) during high stage. A steel sheet piling control is located immediately upstream of the wading section.

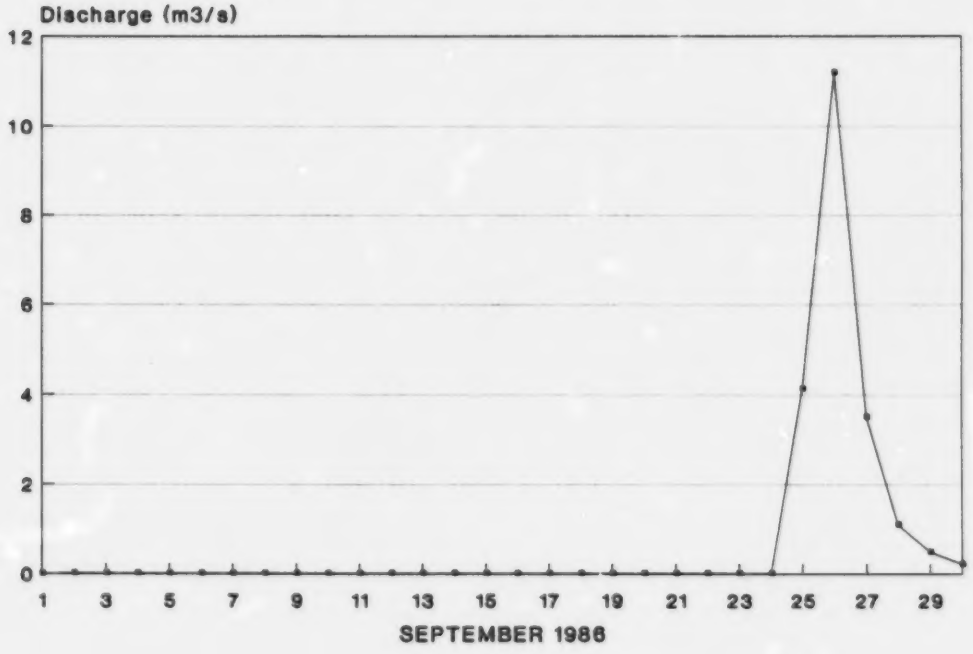
PERIOD OF RECORD: 1911 to present for open water seasons.

RECORDED MAXIMUMS: The two largest maximum instantaneous recorded flows are 34.5 m3/s (06:50 CST Apr.7,1969) and 18.0 m3/s (May 18,1967). Maximum instantaneous values have been calculated for 1967 to present. The two largest maximum daily flows are 72.5 m3/s (Apr.15, 1952) and 25.9 m3/s (Apr.14,1965). The maximum instantaneous flow during the September 1986 flood was 16.0 m3/s (01:37 CST Sept.26) and the maximum daily was 11.2 m3/s (Sept.26).

HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
MIDDLE CREEK NEAR SASKATCHEWAN BOUNDARY
(11AB009)



154

MIDDLE CREEK NEAR THE SASKATCHEWAN BOUNDARY - STATION NO. 11AB009

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	0.0058	12.7	0.316	0.020	0.026	0.016	0.007	0.009	0.102	0.031	---	1
2	---	0.0058	10.9	0.194	0.020	0.023	0.016	0.006	0.011	0.068	0.031	---	2
3	---	0.0058	7.81	0.126	0.019	0.023	0.015	0.006	0.013	0.054	0.033A	---	3
4	---	0.0048	5.53	0.086	0.020	0.022	0.014	0.005	0.018	0.045	---	---	4
5	---	0.0048	4.77	0.065	0.023	0.023	0.016	0.005	0.020	0.040	---	---	5
6	---	0.0048	3.17	0.048	0.022	0.024	0.016	0.005	0.020	0.047	---	---	6
7	---	0.0058	1.32	0.036	0.022	0.027	0.014	0.005	0.020	0.043	---	---	7
8	---	0.0048	1.31	0.032	0.019	0.028	0.012	0.006	0.017	0.039	---	---	8
9	---	0.0048	1.20	0.031	0.022	0.025	0.015	0.005	0.016	0.037	---	---	9
10	---	0.0048	1.12	0.031	0.023	0.022	0.016	0.005	0.018	0.031	---	---	10
11	---	0.0078	0.682	0.028	0.023	0.021	0.015	0.004	0.018	0.031	---	---	11
12	---	0.0058	0.606	0.028	0.022	0.019	0.014	0.004	0.016	0.031	---	---	12
13	---	0.0048	0.267	0.033	0.022	0.021	0.015	0.007	0.015	0.031	---	---	13
14	---	0.0108	0.176	0.033	0.024	0.021	0.013	0.008	0.015	0.030	---	---	14
15	---	0.0118	0.176	0.032	0.028	0.025	0.011	0.011	0.016	0.030	---	---	15
16	---	0.0118	0.155	0.034	0.028	0.022	0.015	0.016	0.016	0.030	---	---	16
17	---	0.0068	0.128	0.033	0.027	0.022	0.020	0.032	0.020	0.037	---	---	17
18	---	0.0048	0.093	0.029	0.025	0.023	0.020	0.031	0.021	0.039	---	---	18
19	---	0.0048	0.069	0.030	0.753	0.023	0.029	0.030	0.020	0.034	---	---	19
20	---	0.0048	0.081	0.029	1.05	0.021	0.029	0.034	0.018	0.031	---	---	20
21	---	0.0088	0.653	0.030	1.05	0.021	0.026	0.021	0.014	0.030	---	---	21
22	---	0.0118	0.777	0.031	0.815	0.018	0.031	0.014	0.013	0.029	---	---	22
23	---	0.0128	0.629	0.026	1.06	0.019	0.032	0.013	0.011	0.029	---	---	23
24	---	0.0148	0.561	0.027	0.949	0.018	0.022	0.012	0.011	0.030	---	---	24
25	---	0.0578	0.287	0.026	0.526	0.017	0.011	0.011	4.12	0.030	---	---	25
26	---	2.60 B	0.607	0.025	0.281	0.016	0.010	0.010	11.2	0.029	---	---	26
27	---	8.17 B	0.248	0.020	0.135	0.016	0.010	0.011	3.50	0.028	---	---	27
28	---	8.67 B	0.121	0.020	0.073	0.018	0.007	0.010	1.10	0.028	---	---	28
29	---		0.406	0.020	0.046	0.018	0.008	0.009	0.487	0.028	---	---	29
30	---		0.622	0.018	0.034	0.018	0.007	0.008	0.210	0.029	---	---	30
31	---		0.437		0.027		0.008	0.008		0.030		---	31
TOTAL	---	18.909	57.544	1.523	7.208	0.640	0.503	0.362	21.022	1.153	---	---	TOTAL
MEAN	---	0.711	1.86	0.051	0.233	0.021	0.016	0.012	0.701	0.037	---	---	MEAN
MAX	---	8.67	12.7	0.316	1.06	0.026	0.032	0.034	11.2	0.102	---	---	MAX
MIN	---	0.005	0.069	0.018	0.018	0.015	0.007	0.004	0.009	0.029	---	---	MIN

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0 402
MAXIMUM DAILY, 12.7 ON MAR 1
MINIMUM DAILY, 0.004 ON AUG 11
MAXIMUM INSTANTANEOUS,
16.0 AT 01 37 CST ON SEP 26

SUMMARY FOR THE MONTHS FEB TO OCT

INTERNATIONAL GAUGING STATION
TYPE OF GAUGE - RECORDING
LOCATION - LAT 49 25 29 N
LONG 110 03 09 W
DRAINAGE AREA, 305 km²
A - MANUAL GAUGE
B - ICE CONDITIONS

REGULATED

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	---	JUL	43 5
FEB	1 720	AUG	31.3
MAR	4 970	SEP	1 820
APR	132	OCT	99.6
MAY	623	NOV	---
JUN	55.3	DEC	---

TOTAL DISCHARGE, 9 490 dam³

REMARKS - SIGNIFICANT RUNOFF OCCURRED IN FEB, OUTSIDE THE STANDARD PERIOD

FREQUENCY ANALYSIS - LOG PEARSON TYPE III DISTRIBUTION
11AB009 MIDDLE CREEK NEAR SASK. BORDER (Max. Inst.)

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	10.019	8.993	0.898	0.957	5.001
LN X SERIES	1.229	2.225	1.810	-1.202	3.624

X(MIN)= 0.026
X(MAX)= 34.500
LOWER OUTLIER LIMIT OF X= 0.018

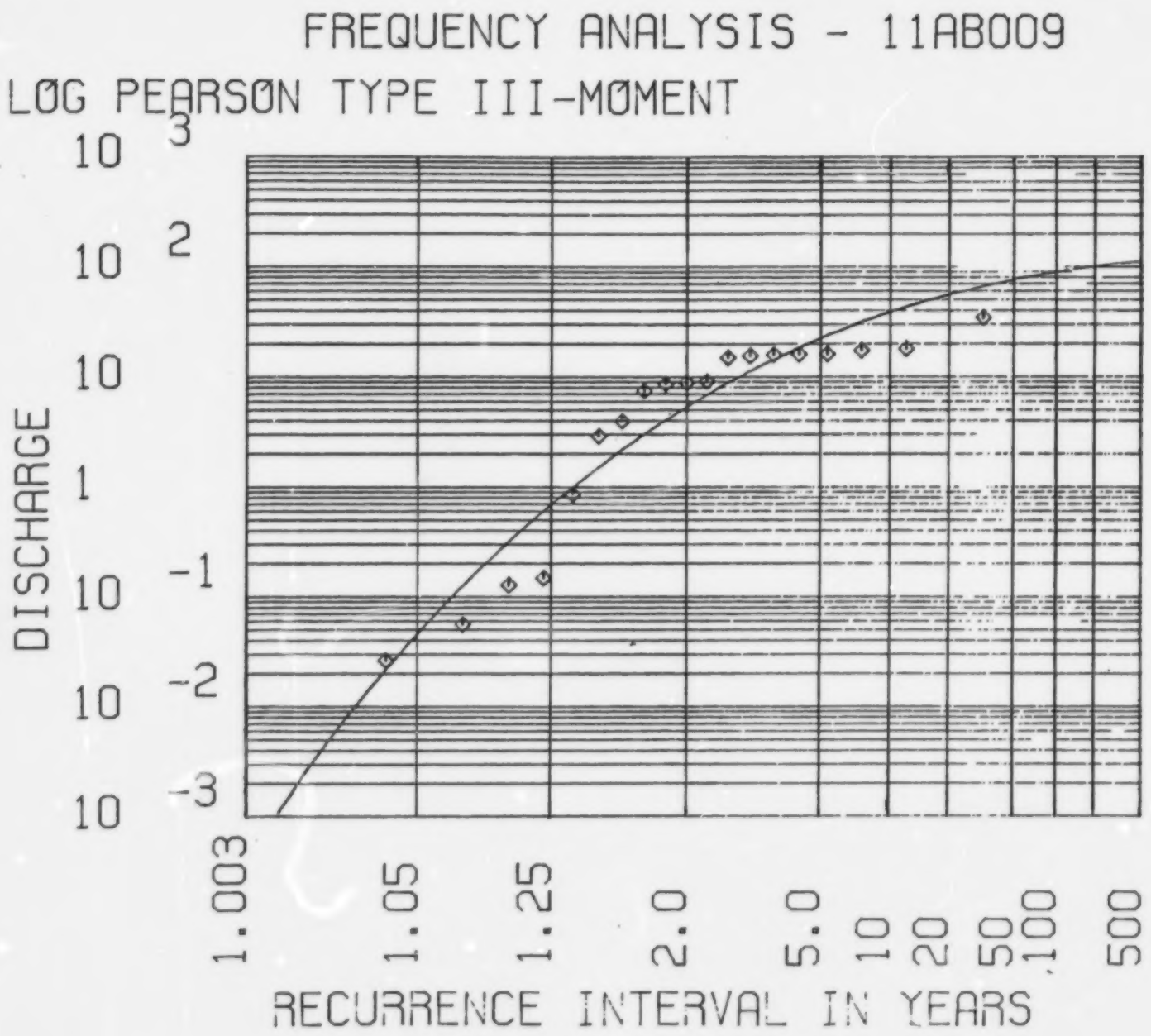
TOTAL SAMPLE SIZE= 19
NO. OF LOW OUTLIERS= 0
NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MOMENTS

DISTRIBUTION IS UPPER BOUNDED AT M= 138.8
LP3 PARAMETERS: A= -1.337 B= 2.770 LOG(M)= 4.933
M = 138.8

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	0.997	0.00
1.050	0.952	0.05
1.250	0.800	0.68
2.000	0.500	5.24
5.000	0.200	22.10
10.000	0.100	38.30
20.000	0.050	54.90
50.000	0.020	75.30
100.000	0.010	88.80
200.000	0.005	100.00
500.000	0.002	113.00


FREQUENCY ANALYSIS - 11AB009
LØG PEARSØN TYPE III-MØMENT
DISCHARGE
10 3
10 2
10
1
10 -1
10 -2
10 -3
1.003
1.05
1.25
2.0
5.0
10
20
50
100
500
RECURRENCE INTERVAL IN YEARS

MIDDLE CREEK BELOW MIDDLE CREEK RESERVOIR
(11AB001)

LOCATION: LAT.49-24-44 N. LONG.109-55-06 W., SW1/4 Sec.25 Twp.5 Rge.30 W3rd.Mer. approximately 21 km north and 8 km west of Govenlock.

DRAINAGE AREA: 385 km2

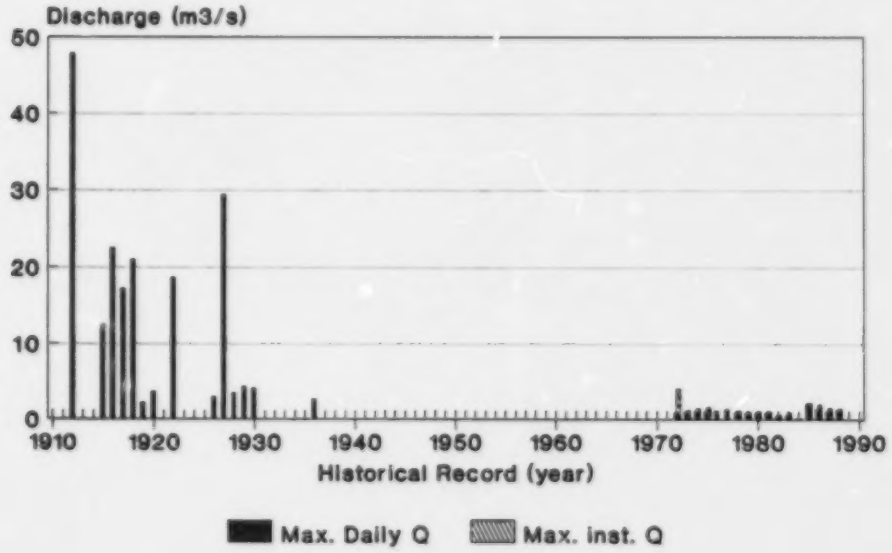
STAGE RECORD: Float activated recorder in standard shelter.

DISCHARGE RECORD: Stage-discharge relationship determined by wading measurement. The control is a corrugated sheet metal weir located 23 m downstream of the gauge.

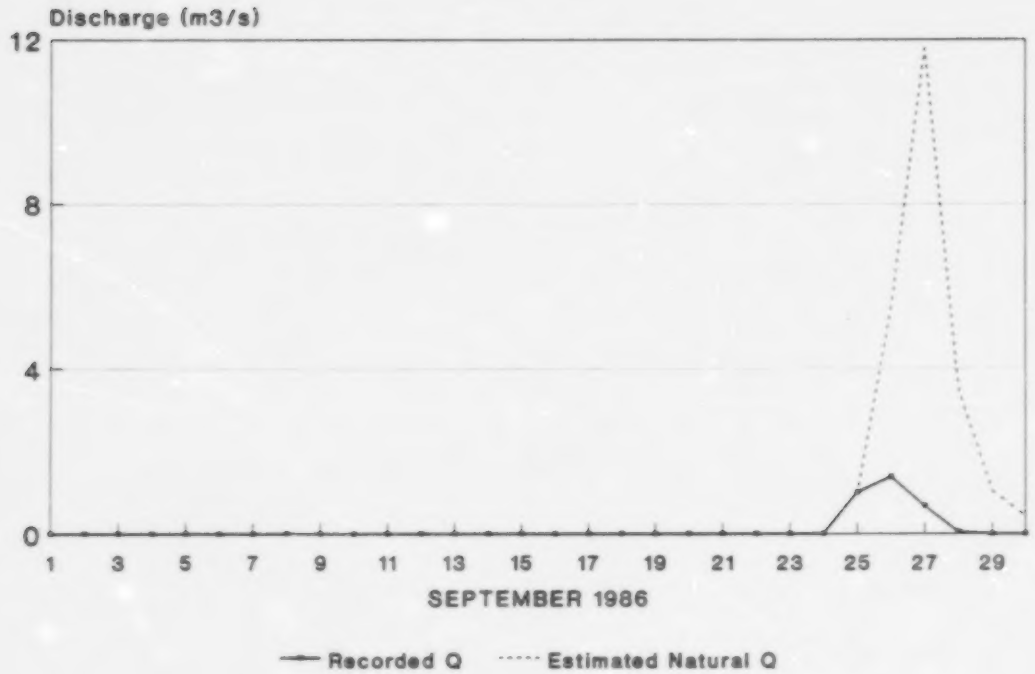
PERIOD OF RECORD: 1909-1936 for open water seasons and the data was published as Middle creek at Wright's Ranch. The station was re-established in 1972 at the present location and has monitored open water seasons to the present time. The station has been regulated since 1937.

RECORDED MAXIMUMS: Maximum instantaneous flows have been calculated since 1972 with the two largest flows recorded being 4.08 m3/s (06:48 CST June 23,1972) and 2.24 m3/s (00:48 CST May 4, 1985). No instantaneous flow data is available for the Sept. 1986 flood. The maximum daily flows recorded are 47.9 m3/s (Apr.5,1912) and 29.4 m3/s (Apr.26,1927). The maximum daily flow during the Sept.1986 flood was 1.39 m3/s (Sept. 26).

HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
MIDDLE CREEK BELOW MIDDLE CREEK RESERVOIR (11AB001)



NATURAL DAILY FLOW ESTIMATION

SEPTEMBER 1986

MIDDLE CREEK BELOW MIDDLE CREEK RESERVOIR

STATION 11AB001

At the time of the flood no flow was being allowed to exit Middle Creek Reservoir. Station Middle Creek below Middle Creek Reservoir (11AB001) was not affected by flows entering Middle Creek Reservoir (as monitored by station Middle Creek near Saskatchewan Boundary, 11AB009). Had the reservoir not been in place, however, flows at 11AB009 (minus channel losses) would have been recorded at station 11AB001 with an estimated 1 day time lag. Channel losses for the Middle Creek Reservoir region have been previously calculated as 4.925 dam^3/day (0.057 m^3/s). Natural flow at 11AB001 was therefore estimated as;

$$NAT\ Q_{001} = RECORDED\ (Q_{009} - CH.LOSSES + Q_{001})$$

The estimated natural peak flow is 11.82 m^3/s on September 27, as compared to 1.39 m^3/s on September 26.

Where:

NAT Q001 = natural discharge at Middle Creek below Middle Creek reservoir

Q009 = recorded discharge at station Middle Creek near Saskatchewan Boundary

Q001 = recorded flow at station Middle Creek below Middle Creek Boundary

WATER SURVEY OF CANADA
OCT 01 1988 PAGE 7807
REGINA, SASK.

MIDDLE CREEK BELOW MIDDLE CREEK RESERVOIR

STATION NO. 11AB001

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	0 B	0.706	0	0.316	0	0	0	0	0	---	---	1
2	---	0 B	0.418	0	0.301	0	0	0	0	0	---	---	2
3	---	0 B	0.234	0	0.113	0	0	0	0	0	---	---	3
4	---	0 B	0.170	0	0	0	0	0	0	0	---	---	4
5	---	0 B	0.135	0	0	0	0	0.010	0	0	---	---	5
6	---	0 B	0.048	0	0.888	0	0	0.189	0	0	---	---	6
7	---	0 B	0.021	0	0.778	0	0	0.248	0	0	---	---	7
8	---	0 B	0.003	0	0.035	0	0	0.205	0	0	---	---	8
9	---	0 B	0.026	0	0.002	0	0	0.257	0	0	---	---	9
10	---	0 B	0.025	0	0	0	0	0.126	0	0	---	---	10
11	---	0 B	0.006	0	0	0	0	0.109	0	0	---	---	11
12	---	0 B	0.001	0	0	0	0	0.080	0	0	---	---	12
13	---	0 B	0	0	0	0	0	0.032	0	0	---	---	13
14	---	0 B	0	0	0	0	0	0.008	0	0	---	---	14
15	---	0 B	0	0	0	0	0	0.002	0	0	---	---	15
16	---	0 B	0	0	0	0	0	0	0	0	---	---	16
17	---	0 B	0	0	0	0	0	0	0	0	---	---	17
18	---	0 B	0	0	0	0	0	0	0	0	---	---	18
19	---	0 B	0	0	0	0	0	0	0	0	---	---	19
20	---	0 B	0	0	0	0	0	0	0	0	---	---	20
21	---	0 B	0	0	0	0	0	0	0	0	---	---	21
22	---	0 B	0	0	0	0	0	0	0	0	---	---	22
23	---	0 B	0	0	0	0	0	0	0	0	---	---	23
24	---	0 B	0	0	0	0	0	0	0	0	---	---	24
25	---	0 B	0	0	0	0	0	0	1.01	0	---	---	25
26	---	0.395B	0	0	0	0	0	0	1.39	0	---	---	26
27	---	0.702	0	0	0	0	0	0	0.674	0	---	---	27
28	---	0.626	0	0.219	0	0	0	0	0.040	0	---	---	28
29	---		0	0.239	0	0	0	0	0.003	0	---	---	29
30	---		0	0.271	0	0	0	0	0.001	0	---	---	30
31	---		0		0		0	0		0		---	31
TOTAL	---	1.723	1.793	0.729	2.433	0	0	1.266	3.118	0	---	---	TOTAL
MEAN	---	0.062	0.058	0.024	0.078	0	0	0.041	0.104	0	---	---	MEAN
MAX	---	0.702	0.706	0.271	0.888	0	0	0.257	1.39	0	---	---	MAX
MIN	---	0	0	0	0	0	0	0	0	0	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0.038
MAXIMUM DAILY, 1.39 ON SEP 26
MINIMUM DAILY, 0 ON MAR 13
MAXIMUM INSTANTANEOUS,
1.998 AT 19:33 CST ON FEB 26

MONTHLY TOTAL DISCHARGE IN CUBIC DECAMETRES

JAN	---	JUL	0
FEB	149	AUG	109
MAR	155	SEP	269
APR	63.0	OCT	0
MAY	210	NOV	---
JUN	0	DEC	---

TOTAL DISCHARGE, 806 DAM3

B - ICE CONDITIONS

MIDDLE CREEK NEAR GOVENLOCK
(11AB108)

LOCATION: LAT.49-13-42 N. LONG.109-48-57 W., NW1/4 Sec.23 Twp.3 Rge.29 W3rd.Mer. approximately 0.5 km north of Govenlock.

DRAINAGE AREA: 655 km2

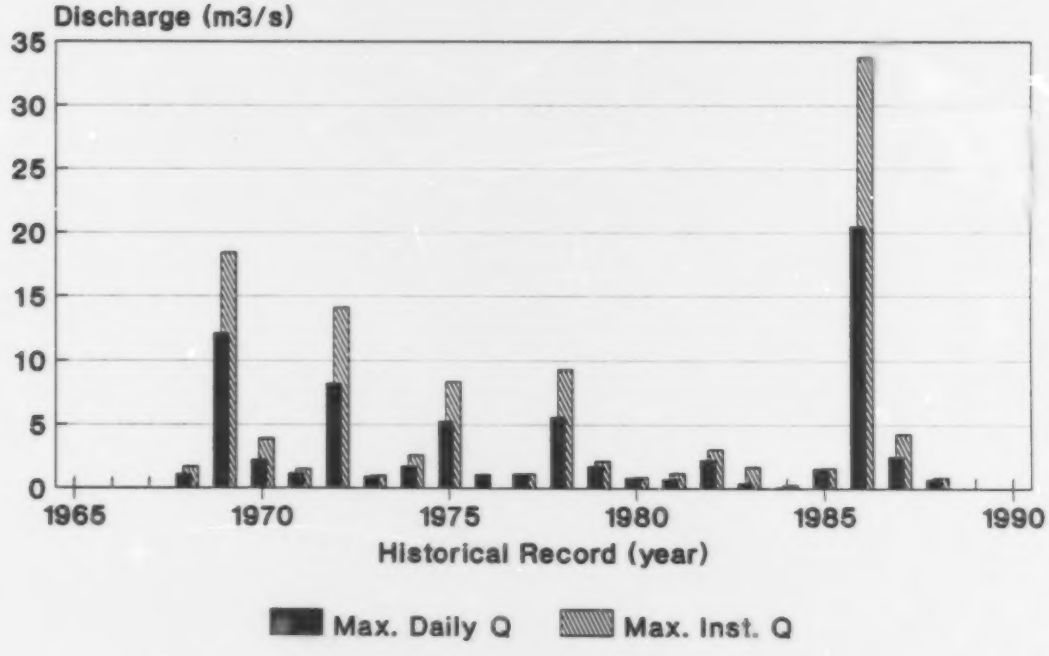
STAGE RECORD: Float activated recorder in standard shelter.

DISCHARGE RECORD: Stage-discharge relationship determined by wading measurements.

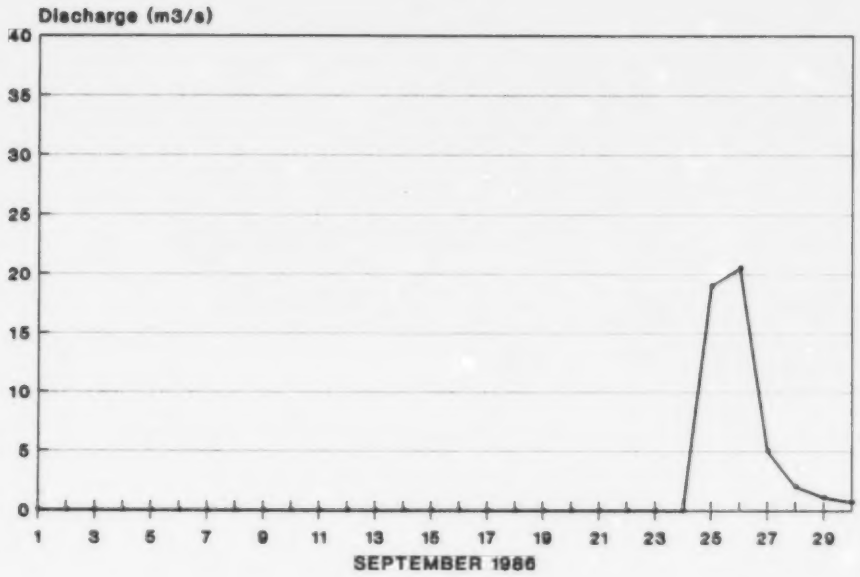
PERIOD OF RECORD: 1968 to present for open water seasons.

RECORDED MAXIMUMS: The maximum instantaneous flow is 33.8 m3/s (18:31 CST Sept. 25,1986). The previous maximum was 18.4 m3/s (22:18 CST Apr.6, 1969). The maximum daily flow is 20.5 m3/s (Sept.26, 1986) with the previous maximum being 12.1 m3/s (Apr. 6, 1969).

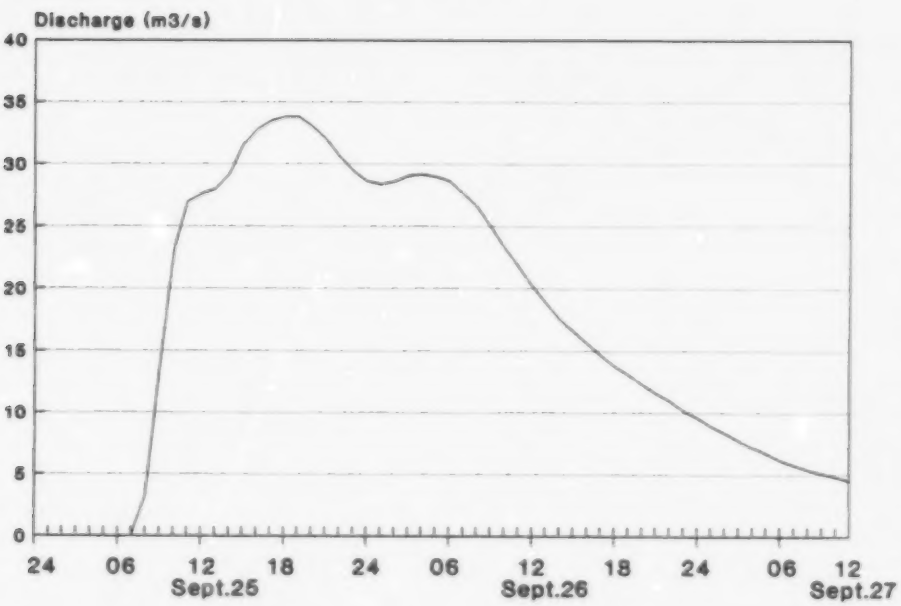
HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
Middle Creek Near Govenlock
(11AB108)



HYDROGRAPH OF HOURLY DISCHARGE
Middle Creek Near Govenlock
(11AB108)



WATER SURVEY OF CANADA
OCT 01 1988 PAGE 9190
REGINA, SASK.

MIDDLE CREEK NEAR GOVENLOCK

STATION NO. 11AB108

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	0.002B	4.00 B	0.074	0.029	0.007	0.002	0	0	0.499	---	---	1
2	---	0.002B	6.00 B	0.074	0.028	0.004	0.001	0	0	0.397	---	---	2
3	---	0.002B	2.40 B	0.098	0.067	0.004	0	0	0	0.322	---	---	3
4	---	0.002B	1.20 B	0.112	0.153	0.002	0	0	0	0.259	---	---	4
5	---	0.002B	0.580B	0.080	0.181	0.001	0.001	0	0	0.204	---	---	5
6	---	0.002B	0.260B	0.067	0.145	0.002	0	0	0	0.171	---	---	6
7	---	0.002B	0.146	0.057	0.082	0.002	0	0	0	0.140	---	---	7
8	---	0.001B	0.188	0.052	0.282	0.011	0	0	0	0.115	---	---	8
9	---	0.001B	0.387	0.050	0.551	0.010	0	0	0	0.101	---	---	9
10	---	0.001B	0.485	0.051	0.197	0.006	0	0	0	0.087	---	---	10
11	---	0.001B	0.537	0.049	0.153	0.005	0	0	0	0.079	---	---	11
12	---	0.001B	0.346	0.046	0.215	0.005	0	0	0	0.072	---	---	12
13	---	0.001B	0.585	0.045	0.262	0.007	0	0	0	0.072	---	---	13
14	---	0.001B	0.179	0.049	0.101	0.005	0	0	0	0.066	---	---	14
15	---	0.001B	0.215	0.049	0.084	0.006	0	0	0	0.064	---	---	15
16	---	0.001B	0.179	0.053	0.075	0.003	0	0	0	0.061	---	---	16
17	---	0.001B	0.176	0.052	0.065	0.002	0	0	0	0.059	---	---	17
18	---	0.001B	0.109	0.050	0.058	0.003	0	0	0	0.058	---	---	18
19	---	0 B	0.149	0.048	0.054	0.006	0	0	0	0.056	---	---	19
20	---	0 B	0.141	0.046	0.051	0.009	0	0	0	0.055	---	---	20
21	---	0 B	0.135	0.045	0.048	0.008	0	0	0	0.056	---	---	21
22	---	0 B	0.147	0.040	0.084	0.006	0	0	0	0.056	---	---	22
23	---	0 B	0.128	0.038	0.080	0.005	0	0	0	0.056	---	---	23
24	---	0 B	0.166	0.035	0.065	0.004	0	0	0	0.056	---	---	24
25	---	0.350B	0.110	0.040	0.066	0.003	0	0	19.0	0.055	---	---	25
26	---	3.50 B	0.118	0.041	0.043	0.002	0	0	20.5	0.055	---	---	26
27	---	4.25 B	0.131	0.041	0.026	0.003	0	0	4.98	0.057	---	---	27
28	---	4.15 B	0.105	0.039	0.020	0.003	0	0	2.04	0.056	---	---	28
29	---		0.089	0.032	0.017	0.004	0	0	1.11	0.054	---	---	29
30	---		0.079	0.029	0.014	0.003	0	0	0.715	0.055A	---	---	30
31	---		0.075		0.010		0	0		0.055E		---	31
TOTAL	---	12.275	19.545	1.582	2.306	0.141	0.004	0	48.345	3.548	---	---	TOTAL
MEAN	---	0.438	0.630	0.053	0.107	0.005	0	0	1.61	0.114	---	---	MEAN
MAX	---	4.25	6.00	0.112	0.551	0.011	0.002	0	20.5	0.499	---	---	MAX
MIN	---	0	0.075	0.029	0.010	0.001	0	0	0	0.054	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0.312
MAXIMUM DAILY, 20.5 ON SEP 26
MINIMUM DAILY, 0 ON JUL 3
MAXIMUM INSTANTANEOUS,
33.8 AT 18:31 CST ON SEP 25

A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	---	JUL	0.35
FEB	1 060	AUG	0
MAR	1 690	SEP	4 180
APR	137	OCT	307
MAY	286	NOV	---
JUN	12.2	DEC	---

TOTAL DISCHARGE, 6 610 DAM3

B12

MIDDLE CREEK NEAR GOVENLOCK

STATION NO. 11AB1CB

MONTH	DAY	YEAR	TIME	DISCHARGES IN M3/S EVERY HOUR								TIME
SEP	21	1986	1-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	
			9-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	8-00
			17-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	16-00
SEP	22	1986	1-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	24-00
			9-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	
			17-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	8-00
SEP	23	1986	1-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	16-00
			9-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	24-00
			17-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	
S	24	1986	1-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8-00
			9-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16-00
			17-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24-00
SEP	25	1986	1-00	0.000	0.001	0.001	0.006	0.009	0.007	0.007	3.179	
			9-00	13.700	23.100	27.000	27.600	28.000	29.200	31.500	32.800	8-00
			17-00	33.500	33.800	33.800	33.000	32.000	30.600	29.400	28.600	16-00
SEP	26	1986	1-00	28.400	28.600	29.100	29.200	29.000	28.600	27.600	26.600	24-00
			9-00	25.000	23.300	21.800	20.200	18.900	17.600	16.600	15.600	
			17-00	14.700	13.800	13.100	12.300	11.600	11.000	10.200	9.570	8-00
SEP	27	1986	1-00	8.930	8.350	7.780	7.210	6.740	6.190	5.760	5.360	16-00
			9-00	5.090	4.820	4.520	4.330	4.140	3.980	3.820	3.690	24-00
			17-00	3.550	3.430	3.320	3.230	3.130	3.030	2.930	2.830	
SEP	28	1986	1-00	2.750	2.660	2.580	2.510	2.440	2.370	2.290	2.220	8-00
			9-00	2.160	2.090	2.040	1.990	1.930	1.880	1.850	1.800	16-00
			17-00	1.750	1.710	1.670	1.620	1.570	1.540	1.500	1.460	24-00
SEP	29	1986	1-00	1.420	1.380	1.350	1.310	1.270	1.230	1.200	1.180	
			9-00	1.150	1.130	1.100	1.080	1.050	1.030	1.010	1.000	8-00
			17-00	0.986	0.971	0.956	0.938	0.921	0.903	0.885	0.868	16-00
SEP	30	1986	1-00	0.858	0.849	0.840	0.829	0.818	0.801	0.784	0.766	24-00
			9-00	0.745	0.726	0.713	0.700	0.689	0.681	0.673	0.660	
			17-00	0.646	0.633	0.624	0.614	0.607	0.599	0.591	0.581	8-00
OCT	1	1986	1-00	0.571	0.560	0.549	0.539	0.535	0.531	0.526	0.521	16-00
			9-00	0.516	0.510	0.505	0.499	0.494	0.490	0.486	0.481	24-00
			17-00	0.475	0.467	0.459	0.451	0.443	0.438	0.435	0.432	
OCT	2	1986	1-00	0.428	0.427	0.426	0.425	0.423	0.419	0.416	0.412	8-00
			9-00	0.408	0.404	0.399	0.395	0.392	0.388	0.385	0.382	16-00
			17-00	0.391	0.379	0.376	0.373	0.369	0.366	0.362	0.358	24-00

MIDDLE CREEK ABOVE LODGE CREEK
(11AB008)

LOCATION: LAT. 49-06-01 N. LONG. 109-49-02 W., NE1/4 Sec.4 Twp.2 Rge.29 W3rd.Mer. approximately 14 km south of Govenlock on HWY. 21.

DRAINAGE AREA: 717 km2

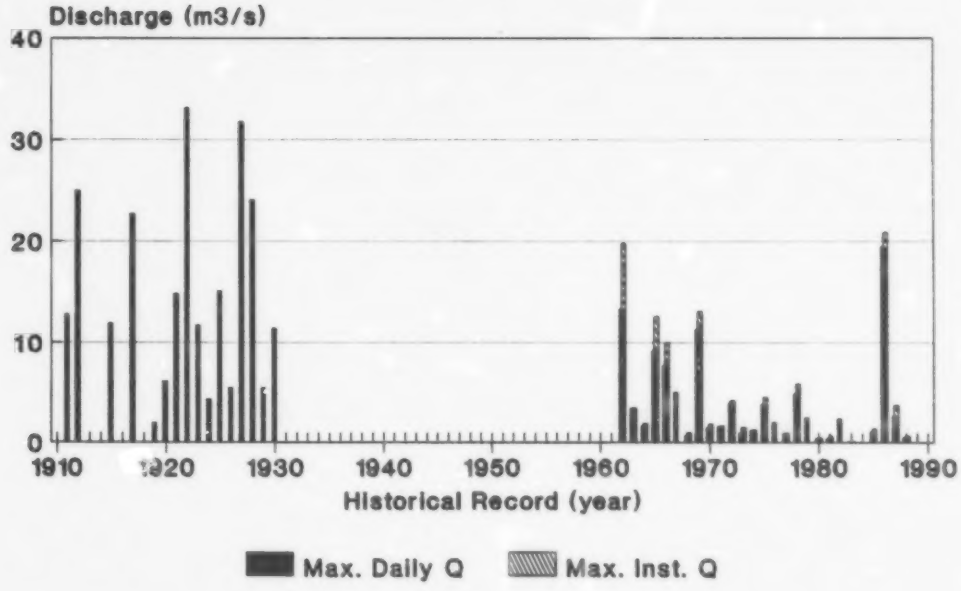
STAGE RECORD: Float activated recorder in standard shelter.

DISCHARGE RECORD: Stage-discharge relationship determined using wading and cableway measurements.

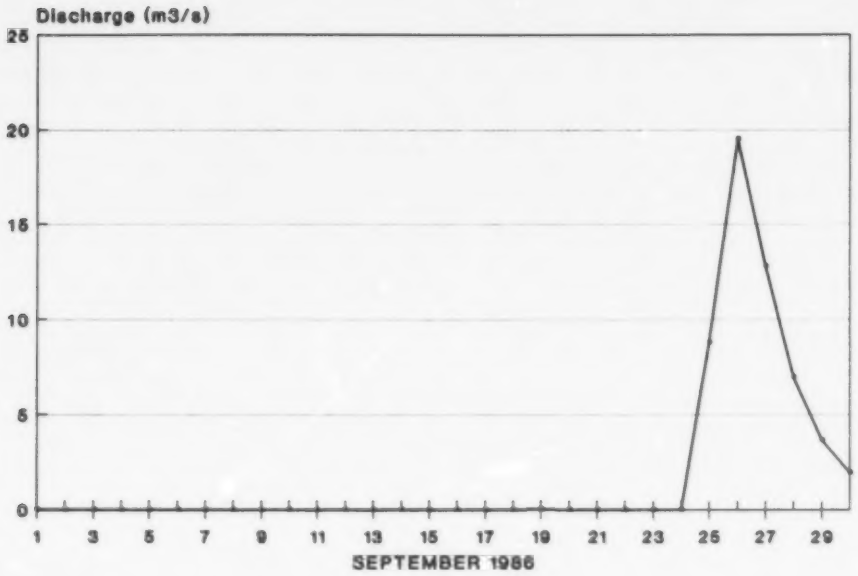
PERIOD OF RECORD: 1911 to 1931 and 1962 to present for open water seasons.

RECORDED MAXIMUMS: Maximum instantaneous flows have been calculated for the period 1962 to present with a resulting high of 20.9 m3/s (12:40 CST Sept.26, 1986). The previous high was 19.8 m3/s (12:00 MST June 14, 1962). The maximum recorded daily flow is 33.1 m3/s (Apr.24,1922). The daily flow during the Sept. 1986 flood reached 19.5 m3/s (Sept.26) which is the sixth highest recorded flow for that station.

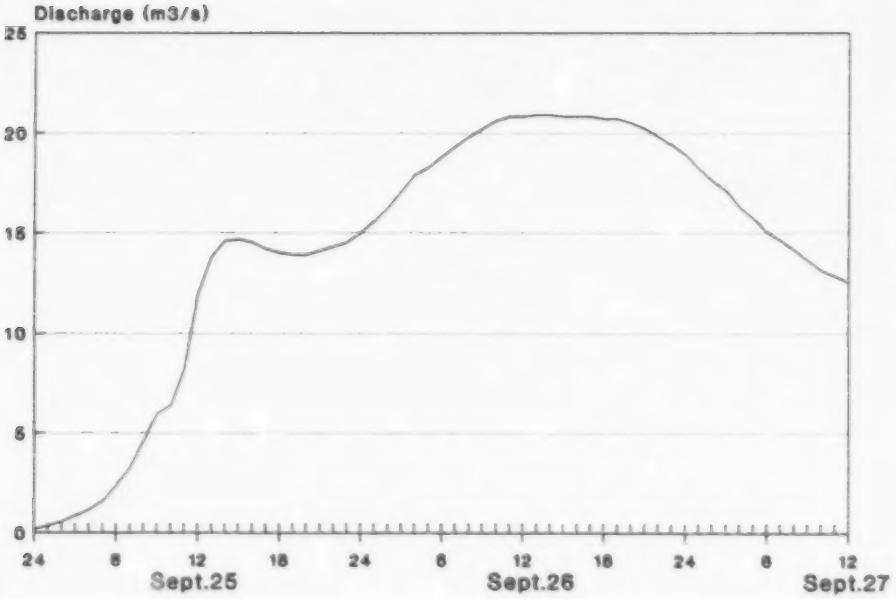
HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
Middle Creek above Lodge Creek
(11AB008)



HYDROGRAPH OF HOURLY DISCHARGE
Middle Creek above Lodge Creek
(11AB008)



WATER SURVEY OF CANADA
OCT 01 1988 PAGE 7943
REGINA, SASK.

MIDDLE CREEK ABOVE LODGE CREEK

STATION NO. 11AB008

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	0 B	6.24	0.012	0.050	0.007	0.001	0	0	1.29	---	---	1
2	---	0 B	6.84	0.011	0.050	0.005	0	0	0	0.958	---	---	2
3	---	0 B	7.48	0.010	0.049	0.003	0	0	0	0.858	---	---	3
4	---	0 B	3.23	0.007	0.042	0.001	0	0	0	0.814	---	---	4
5	---	0 B	0.813	0.005	0.044	0	0	0	0	0.723	---	---	5
6	---	0 B	0.148	0.006	0.030	0	0	0	0	0.260	---	---	6
7	---	0 B	0.075	0.086	0.022	0	0	0	0	0.090	---	---	7
8	---	0 B	0.050	0.061	0.020	0	0	0	0	0.075	---	---	8
9	---	0 B	0.066	0.012	0.031	0.004	0	0	0	0.068	---	---	9
10	---	0 B	0.058	0.008	0.046	0.011	0	0	0	0.062	---	---	10
11	---	0 B	0.059	0.008	0.073	0.008	0	0	0	0.060	---	---	11
12	---	0 B	0.060	0.009	0.155	0.003	0	0	0	0.112	---	---	12
13	---	0 B	0.060	0.007	0.243	0.002	0	0	0	0.140	---	---	13
14	---	0 B	0.309	0.006	0.213	0	0	0	0	0.141	---	---	14
15	---	0 B	0.556	0.006	0.188	0	0	0	0	0.135	---	---	15
16	---	0 B	0.440	0.006	0.135	0	0	0	0	0.130	---	---	16
17	---	0 B	0.232	0.007	0.112	0	0.001	0	0	0.126	---	---	17
18	---	0 B	0.115	0.005	0.108	0	0	0	0	0.118	---	---	18
19	---	0 B	0.115	0.004	0.079	0.001	0	0	0.020	0.109	---	---	19
20	---	0 B	0.095	0.003	0.046	0	0	0	0.010	0.109	---	---	20
21	---	0 B	0.062	0.002	0.038	0	0	0	0.007	0.102	---	---	21
22	---	0 B	0.048	0.002	0.072	0	0	0	0.002	0.094	---	---	22
23	---	0 B	0.039	0.002	0.102	0	0	0	0	0.090	---	---	23
24	---	0 B	0.032	0.147	0.150	0	0.001	0	0.003	0.088	---	---	24
25	---	0 B	0.027	0.172	0.147	0	0	0	8.81	0.088	---	---	25
26	---	0.0438	0.912	0.068	0.140	0	0	0	19.5	0.083	---	---	26
27	---	0.517	0.015	0.063	0.082	0	0	0	12.8	0.083	---	---	27
28	---	3.19	0.027	0.060	0.032	0	0	0	6.99	0.078	---	---	28
29	---		0.015	0.055	0.022	0	0	0	3.67	0.073	---	---	29
30	---		0.015	0.052	0.017	0.001	0	0	1.96	0.075A	---	---	30
31	---		0.013		0.011		0	0		0.075E		---	31
TOTAL	---	3.750	27.346	0.902	2.549	0.046	0.003	0	53.772	7.307	---	---	TOTAL
MEAN	---	0.134	0.882	0.030	0.082	0.002	0	0	1.79	0.236	---	---	MEAN
MAX	---	3.19	7.48	0.172	0.243	0.011	0.001	0	19.5	1.29	---	---	MAX
MIN	---	0	0.012	0.002	0.011	0	0	0	0	0.060	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0.375
MAXIMUM DAILY, 19.5 ON SEP 26
MINIMUM DAILY, 0 ON JUN 5
MAXIMUM INSTANTANEOUS,
20.9 AT 12:40 CST ON SEP 26

A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	---	JUL	0.26
FEB	324	AUG	0
MAR	2 360	SEP	4 650
APR	77.9	OCT	631
MAY	220	NOV	---
JUN	3.97	DEC	---

TOTAL DISCHARGE, 7 940 DAM3

MIDDLE CREEK ABOVE LODGE CREEK

STATION NO. 11AB008

MONTH	DAY	YEAR	TIME	DISCHARGES IN M3/S EVERY HOUR								TIME
SEP	21	1986	1-00	0.013	0.013	0.012	0.011	0.010	0.009	0.009	0.008	8-00
			9-00	0.008	0.007	0.007	0.007	0.006	0.006	0.006	0.006	16-00
			17-00	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	24-00
SEP	22	1986	1-00	0.004	0.004	0.004	0.004	0.003	0.003	0.003	0.003	8-00
			9-00	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.001	16-00
			17-00	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	24-00
SEP	23	1986	1-00	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000	8-00
			9-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16-00
			17-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24-00
SEP	24	1986	1-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8-00
			9-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16-00
			17-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.191	24-00
SEP	25	1986	1-00	0.356	0.551	0.847	1.150	1.560	2.380	3.290	4.570	8-00
			9-00	5.960	6.380	8.230	11.900	13.800	14.600	14.700	14.500	16-00
			17-00	14.200	14.000	13.900	13.900	14.100	14.300	14.500	15.000	24-00
SEP	26	1986	1-00	15.600	16.300	17.100	17.900	18.300	18.800	19.300	19.800	8-00
			9-00	20.200	20.600	20.800	20.800	20.900	20.900	20.800	20.800	16-00
			17-00	20.800	20.700	20.700	20.500	20.200	19.800	19.400	18.900	24-00
SEP	27	1986	1-00	18.200	17.600	17.100	16.300	15.700	15.000	14.600	14.100	8-00
			9-00	13.600	13.100	12.800	12.500	12.000	11.700	11.200	10.800	16-00
			17-00	10.400	9.990	9.700	9.460	9.240	9.010	8.850	8.690	24-00
SEP	28	1986	1-00	8.510	8.330	8.160	8.010	7.860	7.710	7.570	7.430	8-00
			9-00	7.300	7.190	7.080	6.970	6.360	6.750	6.630	6.510	16-00
			17-00	6.380	6.250	6.120	5.990	5.830	5.670	5.520	5.360	24-00
SEP	29	1986	1-00	5.230	5.070	4.840	4.700	4.560	4.380	4.180	4.030	8-00
			9-00	3.900	3.760	3.630	3.510	3.400	3.280	3.180	3.100	16-00
			17-00	3.010	2.910	2.830	2.760	2.690	2.610	2.530	2.450	24-00
SEP	30	1986	1-00	2.400	2.350	2.290	2.250	2.200	2.160	2.120	2.080	8-00
			9-00	2.040	2.000	1.950	1.920	1.890	1.860	1.830	1.810	16-00
			17-00	1.780	1.740	1.710	1.680	1.650	1.620	1.600	1.580	24-00
OCT	1	1986	1-00	1.550	1.530	1.500	1.470	1.450	1.420	1.390	1.360	8-00
			9-00	1.340	1.320	1.300	1.280	1.250	1.230	1.210	1.200	16-00
			17-00	1.180	1.160	1.130	1.110	1.090	1.080	1.060	1.050	24-00
OCT	2	1986	1-00	1.040	1.030	1.020	1.010	0.999	0.994	0.989	0.984	8-00
			9-00	0.975	0.966	0.958	0.949	0.940	0.935	0.930	0.924	16-00
			17-00	0.919	0.917	0.915	0.914	0.912	0.906	0.900	0.896	24-00

LODGE CREEK NEAR ALBERTA BOUNDARY
(11AB082)

LOCATION: LAT. 49-12-10-N. LONG. 109-59-05 W. NW1/4 Sec 9 Twp.3 Rge.30 W.3rd.Mer. approximately 14 km west of Govenlock on HWY. 13.

DRAINAGE AREA: 909 km2

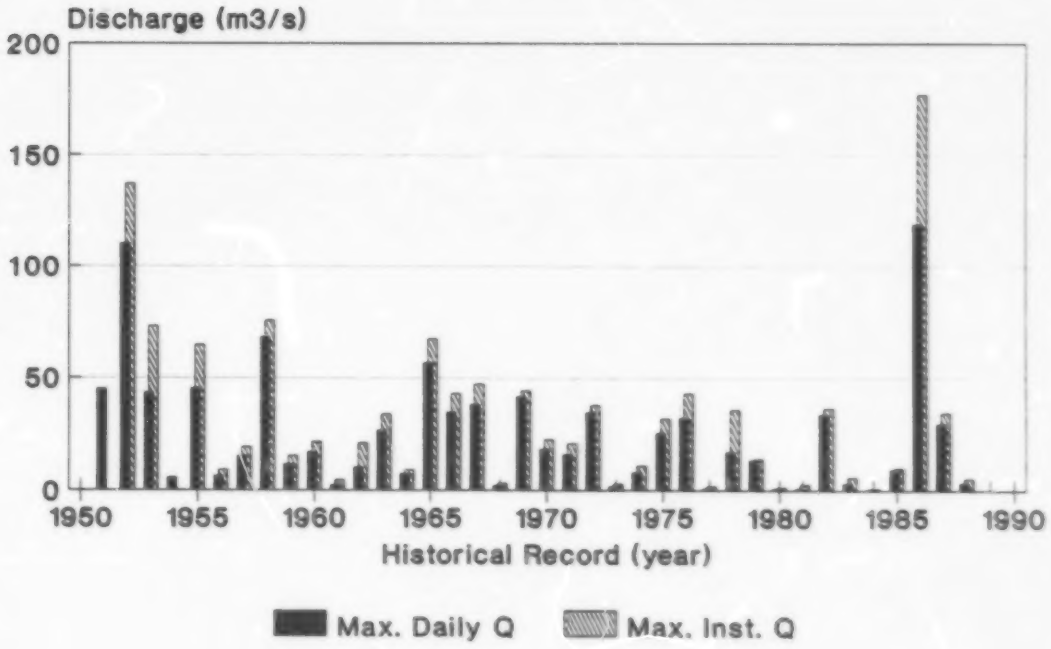
STAGE RECORD: Float activated recorder, data collection platform and Memomark 3 system in a standard shelter.

DISCHARGE RECORD: Stage-discharge relationship determined by wading and bridge measurements.

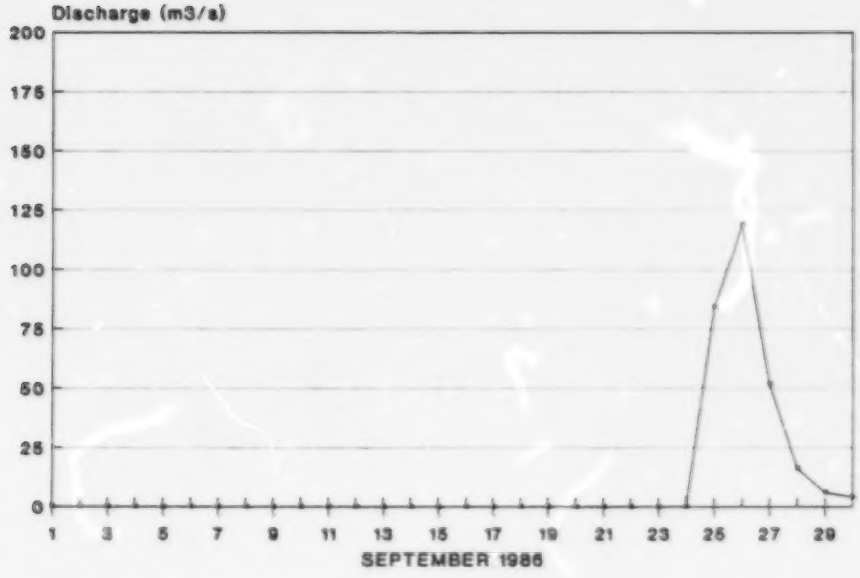
PERIOD OF RECORD: 1951 to present for open water seasons.

RECORDED MAXIMUMS: The maximum instantaneous recorded flow is 177 m3/s (00:37 CST Sept.26,1986) with the next largest flow beirg 137 m3/s (10:00 MST Apr.16, 1952). The maximum daily flow is 119 m3/s (Sept. 26, 1986) with a previous maximum of 110 m3/s (Apr.16,1952)

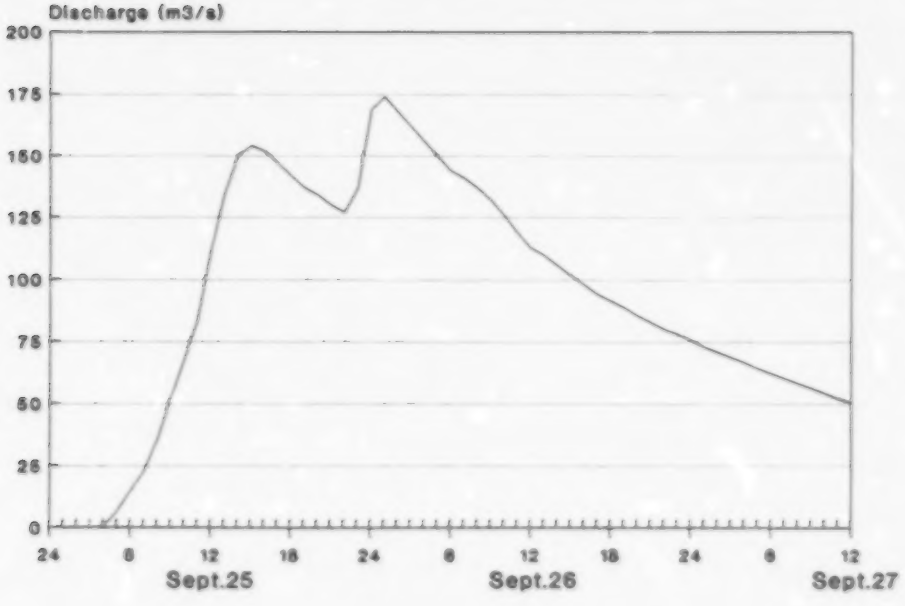
HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
Lodge Creek at Alberta Boundary
(11AB082)



HYDROGRAPH OF HOURLY DISCHARGE
Lodge Creek at Alberta Boundary
(11AB082)



WATER SURVEY OF CANADA
OCT 01 1988 PAGE 8835
REGINA, SASK.

LODGE CREEK NEAR ALBERTA BOUNDARY

STATION NO. 11AB082

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	0.020B	22.9 B	0.887	0.073	0.289	0.009	0	0	3.28	0.129	---	1
2	---	0.020B	17.3 B	0.767	0.074	0.230	0.007	0	0	2.87	0.129	---	2
3	---	0.020B	15.6 B	0.607	0.072	0.180	0.005	0	0	3.68	0.129A	---	3
4	---	0.019B	10.2 B	0.501	0.084	0.146	0.002	0	0	3.14	---	---	4
5	---	0.011B	7.74 B	0.421	0.105	0.127	0.003	0	0	2.29	---	---	5
6	---	0.009B	5.71	0.348	0.092	0.146	0.001	0	0	1.66	---	---	6
7	---	0.002B	4.15	0.286	0.088	0.163	0.001	0	0	1.07	---	---	7
8	---	0 B	2.19	0.250	0.440	0.155	0	0	0	0.736	---	---	8
9	---	0.004B	1.88	0.239	0.351	0.141	0	0	0	0.537	---	---	9
10	---	0.063B	2.35	0.223	0.538	0.096	0	0	0	0.386	---	---	10
11	---	0.083B	2.36	0.205	0.462	0.059	0	0	0	0.305	---	---	11
12	---	0.065B	1.89	0.222	0.386	0.262	0	0	0	0.279	---	---	12
13	---	0.057B	1.39	0.242	0.370	0.263	0	0	0	0.254	---	---	13
14	---	0.034B	1.20	0.229	0.418	0.205	0	0	0	0.239	---	---	14
15	---	0.037B	1.14	0.196	0.410	0.166	0	0	0	0.227	---	---	15
16	---	0.038B	1.18	0.163	0.389	0.109	0	0	0	0.228	---	---	16
17	---	0.027B	1.07	0.133	0.371	0.078	0.004	0	0	0.217	---	---	17
18	---	0.015B	0.899	0.105	2.33	0.059	0.003	0	0	0.208	---	---	18
19	---	0.009B	0.763	0.090	2.66	0.038	0.001	0	0	0.192	---	---	19
20	---	0.007B	0.642	0.092	3.59	0.024	0	0	0.034	0.195	---	---	20
21	---	0.005B	2.39	0.091	4.20	0.020	0	0	0.025	0.188	---	---	21
22	---	0.002B	3.78	0.090	3.80	0.014	0	0	0.011	0.164	---	---	22
23	---	0 B	3.60	0.066	3.46	0.008	0.001	0	0.007	0.157	---	---	23
24	---	0 B	2.12	0.065	3.70	0.005	0.002	0	0.024	0.151	---	---	24
25	---	0.041B	1.39	0.074	2.79	0.002	0.001	0	84.3	0.148	---	---	25
26	---	25.0 B	1.09	0.064	1.65	0.001	0	0	119	0.145	---	---	26
27	---	40.8 B	0.899	0.064	1.13	0.001	0	0	51.7	0.142	---	---	27
28	---	27.8 B	0.791	0.078	0.928	0.001	0	0	16.2	0.138	---	---	28
29	---		0.904	0.090	0.740	0.010	0	0	6.09	0.133	---	---	29
30	---		1.22	0.087	0.546	0.013	0	0	4.15	0.135	---	---	30
31	---		1.13		0.400		0	0		0.133		---	31
TOTAL	---	94.188	121.868	6.975	36.847	3.011	0.040	0	281.541	23.627	---	---	TOTAL
MEAN	---	3.36	3.93	0.233	1.19	0.100	0.001	0	9.38	0.762	---	---	MEAN
MAX	---	40.8	22.9	0.887	4.20	0.289	0.009	0	119	3.68	---	---	MAX
MIN	---	0	0.642	0.064	0.072	0.001	0	0	0	0.133	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 1.93
MAXIMUM DAILY, 119 ON SEP 26
MINIMUM DAILY, 0 ON JUL 8
MAXIMUM INSTANTANEOUS,
177 AT 00:37 CST ON SEP 26

A - MANUAL GAUGE
B - ICE CONDITIONS

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	---	JUL	3.46
FEB	8 140	AUG	0
MAR	10 500	SEP	24 300
APR	603	OCT	2 040
MAY	3 180	NOV	---
JUN	260	DEC	---

TOTAL DISCHARGE, 40 900 DAM3

LODGE CREEK NEAR ALBERTA BOUNDARY

STATION NO. 11AB082

MONTH	DAY	YEAR	TIME	DISCHARGES IN M3/S EVERY HOUR								TIME
SEP	21	1986	1-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8-00
			9-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16-00
			17-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24-00
SEP	22	1986	1-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8-00
			9-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16-00
			17-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24-00
SEP	23	1986	1-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8-00
			9-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16-00
			17-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24-00
SEP	24	1986	1-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8-00
			9-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16-00
			17-00	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.005	24-00
SEP	25	1986	1-00	0.009	0.036	0.060	0.195	6.570	14.800	22.700	35.400	8-00
			9-00	52.000	67.600	83.900	112.000	135.000	150.000	154.000	152.000	16-00
			17-00	147.000	142.000	137.000	134.000	130.000	127.000	137.000	169.000	24-00
SEP	26	1986	1-00	174.000	168.000	162.000	156.000	150.000	144.000	141.000	137.000	8-00
			9-00	132.000	126.000	119.000	113.000	110.000	106.000	102.000	98.300	16-00
			17-00	94.400	91.600	89.100	85.700	82.900	80.300	78.000	75.700	24-00
SEP	27	1986	1-00	73.000	70.600	68.800	66.600	64.300	62.100	60.300	58.200	8-00
			9-00	56.400	54.200	52.200	50.600	49.000	47.100	45.600	43.900	16-00
			17-00	42.300	40.700	38.800	37.200	35.900	34.700	33.300	32.100	24-00
SEP	28	1986	1-00	30.400	27.900	26.500	25.300	23.900	22.500	20.900	19.500	8-00
			9-00	18.000	16.800	15.500	14.200	12.900	11.800	11.100	10.500	16-00
			17-00	9.960	9.530	9.130	8.820	8.570	8.330	8.070	7.870	24-00
SEP	29	1986	1-00	7.690	7.490	7.290	7.140	6.990	6.830	6.680	6.520	8-00
			9-00	6.360	6.210	6.070	5.930	5.840	5.760	5.650	5.530	16-00
			17-00	5.420	5.300	5.200	5.110	5.020	4.940	4.880	4.820	24-00
SEP	30	1986	1-00	4.760	4.690	4.610	4.540	4.450	4.370	4.320	4.290	8-00
			9-00	4.270	4.240	4.200	4.170	4.120	4.060	3.990	3.930	16-00
			17-00	3.900	3.860	3.820	3.770	3.720	3.660	3.600	3.540	24-00
OCT	1	1986	1-00	3.490	3.450	3.420	3.390	3.370	3.340	3.320	3.300	8-00
			9-00	3.280	3.270	3.260	3.250	3.250	3.240	3.240	3.230	16-00
			17-00	3.230	3.220	3.210	3.190	3.170	3.150	3.140	3.130	24-00
OCT	2	1986	1-00	3.120	3.100	3.090	3.080	3.070	3.060	3.050	3.040	8-00
			9-00	3.030	2.960	2.900	2.880	2.870	2.870	2.870	2.870	16-00
			17-00	2.850	2.830	2.830	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	24-00

FREQUENCY ANALYSIS - WAKEBY DISTRIBUTION
11AB082 LODGE CREEK NEAR ALBERTA BOUNDRY

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	33.654	38.342	1.139	2.254	9.302
LN X SERIES	2.854	1.324	0.464	-0.522	2.895

X(MIN)= 0.945
X(MAX)= 177.000
LOWER OUTLIER LIMIT OF X= 0.544

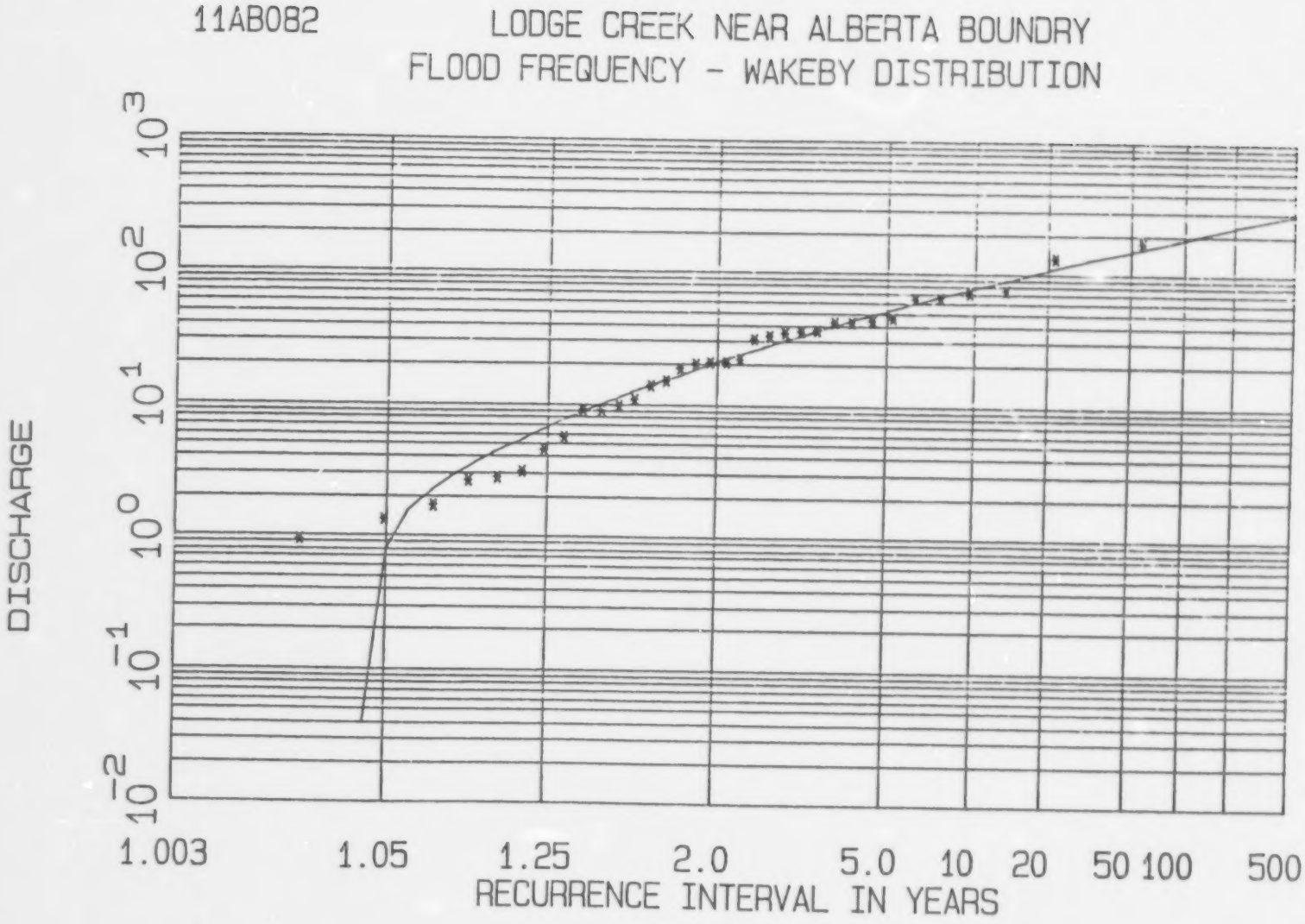
TOTAL SAMPLE SIZE= 34
NO. OF LOW OUTLIERS= 0
NO. OF ZERO FLOWS= 0

THE FOLLOWING WAKEBY PARAMETERS WERE OBTAINED VIA ITERATION FOR PARAMETER B, ASSUMING M TO BE NON-ZERO.

M= -7.188 A= 7.414 B= 45.03 C= 191.387 D= 0.149

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	0.997	-
1.050	0.952	0.80
1.250	0.800	6.71
2.000	0.500	21.10
5.000	0.200	52.20
10.000	0.100	78.70
20.000	0.050	108.00
50.000	0.020	152.00
100.000	0.010	189.00
200.000	0.005	231.00
500.000	0.002	293.00


11AB082
LODGE CREEK NEAR ALBERTA BOUNDRY
FLOOD FREQUENCY - WAKEBY DISTRIBUTION
DISCHARGE
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
1.003
1.05
1.25
2.0
5.0
10
20
50
100
500
RECURRENCE INTERVAL IN YEARS

SQUAW COULEE NEAR WILLOW CREEK
(11AB103)

LOCATION: LAT.49-02-11 N. LONG.109-48-43 W., NW1/4 Sec.15 Twp.1 Rge.29 W3rd.Mer. approximately 21 km south of Govenlock on HWY.21 and 4 km north of the International Boundary.

DRAINAGE AREA: 102 km2

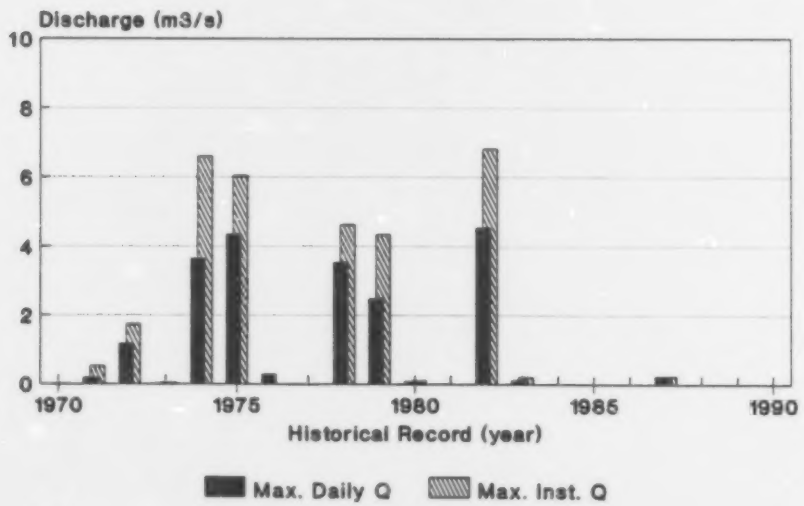
STAGE RECORD: Stage activated recorder in a standard shelter

DISCHARGE RECORD: Wading and bridge measurements are taken to determine the stage discharge relationship.

PERIOD OF RECORD: Intermittent records from 1966 to present for open water seasons.

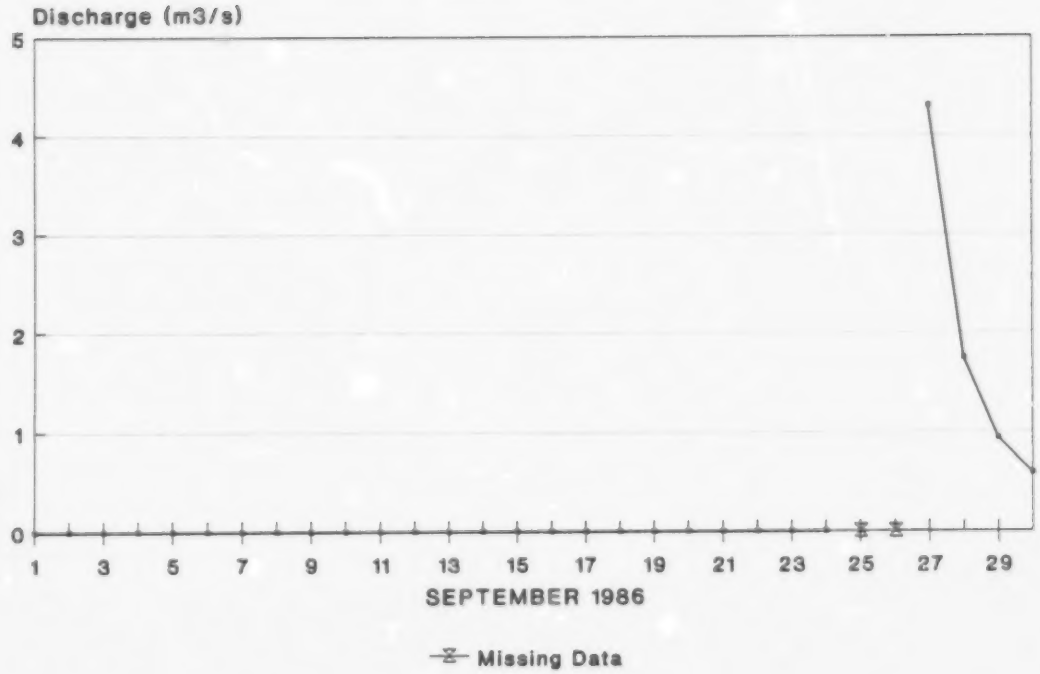
RECORDED MAXIMUMS: The maximum recorded instantaneous and daily discharges are 6.82 m3/s (02:30 CST May 30, 1982), and 4.55 m3/s (May 30, 1982), respectively. The next highest flows are a maximum instantaneous of 6.60 m3/s (03:49 CST May 14, 1974) and a maximum daily of 4.36 m3/s (April 21, 1975). The maximum recorded daily value for 1986 is 4.3 m3/s (Sept.27, 1986). Flows on September 25 and 26 rose to levels beyond the range of the existing head-discharge relation.While an attempt was made to extend the relation through head-area and head-velocity relationships, the resultant values were deemed unreliable due to the backwater effects of the bridge and road, located downstream of the gauge. As a result the flows for September 25, 26 are unknown.

HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE

Squaw Coulee near Willow Creek
(11AB103)



WATER SURVEY OF CANADA
OCT 01 1988 PAGE 9070
REGINA, SASK.

SQUAW COULEE NEAR WILLOW CREEK

STATION NO. 11AB103

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	1.93 B	0.001	0	0.002	0	0	0	0.377	---	---	1
2	---	---	1.73 E	0	0	0.001	0	0	0	0.270	---	---	2
3	---	---	1.45 A	0	0	0	0	0	0	0.188	---	---	3
4	---	---	1.31	0	0	0	0	0	0	0.143	---	---	4
5	---	---	0.960	0	0	0.018	0	0	0	0.109	---	---	5
6	---	---	0.456A	0	0	0.075	0	0	0	0.086	---	---	6
7	---	---	0.097A	0	0	0.093	0	0	0	0.071	---	---	7
8	---	---	0.147E	0	0	0.106	0	0	0	0.057	---	---	8
9	---	---	0.128E	0	0	0.083	0	0	0	0.050	---	---	9
10	---	---	0.107E	0	0	0.049	0	0	0	0.038	---	---	10
11	---	---	0.091E	0	0	0.031	0	0	0	0.031	---	---	11
12	---	---	0.058A	0	0.158	0.022	0	0	0	0.026	---	---	12
13	---	---	0.037	0	0.100	0.021	0	0	0	0.021	---	---	13
14	---	---	0.021	0	0.029	0.020	0	0	0	0.017	---	---	14
15	---	---	0.008	0	0.014	0.016	0	0	0	0.015	---	---	15
16	---	---	0.588	0	0.009	0.011	0	0	0	0.013	---	---	16
17	---	---	0.094	0	0.005	0.006	0	0	0	0.011	---	---	17
18	---	---	0.021	0	0.002	0.009	0	0	0	0.009	---	---	18
19	---	---	0.006	0	0.001	0.034	0	0	0	0.007	---	---	19
20	---	---	0.009	0	0	0.040	0	0	0	0.005	---	---	20
21	---	---	0.406	0	0	0.018	0	0	0	0.005	---	---	21
22	---	---	1.47	0	0.006	0.010	0	0	0	0.004	---	---	22
23	---	---	0.277	0	0.022	0.006	0	0	0	0.003	---	---	23
24	---	0 B	0.171	0	0.288	0.004	0	0	0	0.003	---	---	24
25	---	0.210B	0.141	0	0.315	0.002	0	0	---	0.002	---	---	25
26	---	0.390B	0.093	0	0.112	0.001	0	0	---	0.002	---	---	26
27	---	0.700B	0.065	0	0.046	0.001	0	0	4.30 A	0.002	---	---	27
28	---	1.30 B	0.041	0	0.025	0	0	0	1.74	0.001	---	---	28
29	---		0.022	0	0.014	0	0	0	0.933	0.001	---	---	29
30	---		0.010	0	0.008	0	0	0	0.585	0.001A	---	---	30
31	---		0.002		0.004		0	0		0.001E		---	31
TOTAL	---	---	11.946	0.001	1.158	0.679	0	0	---	1.569	---	---	TOTAL
MEAN	---	---	0.385	0	0.037	0.023	0	0	---	0.051	---	---	MEAN
MAX	---	---	1.93	0.001	0.315	0.106	0	0	---	0.377	---	---	MAX
MIN	---	---	0.002	0	0	0	0	0	---	0.001	---	---	MIN

DISCHARGES IN CUBIC METRES PER SECOND

SUMMARY FOR THE MONTHS MAR TO OCT

MINIMUM DAILY, 0 ON APR 2

MONTHLY TOTAL DISCHARGE IN CUBIC DECAMETRES

JAN	---	JUL	0
FEB	---	AUG	0
MAR	1 030	SEP	---
APR	0.09	OCT	136
MAY	100	NOV	---
JUN	58.7	DEC	---

A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED

LODGE CREEK BELOW McRAE CREEK AT INTERNATIONAL BOUNDARY (11AB083)

LOCATION: LAT. 49-00-19 N. LONG. 109-43-02 W., SW1/4 Sec.5 Twp.1 Rge.28 W3rd.Mer. approximately 27.5 km south of the junction of highways 13 and 21 and 1.6 km east of the Willow Creek Custom's post.

DRAINAGE AREA: 2140 km2

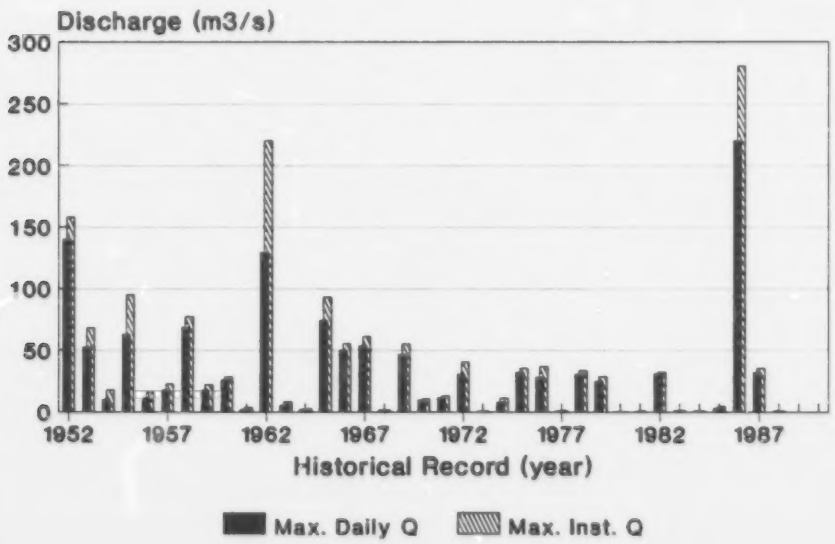
STAGE RECORD: Float activated recorder and telemark system in a standard shelter.

DISCHARGE RECORD: Stage-discharge relationship determined from measurements by wading or cableway. A concrete Trenton type weir is located 14 m below the station.

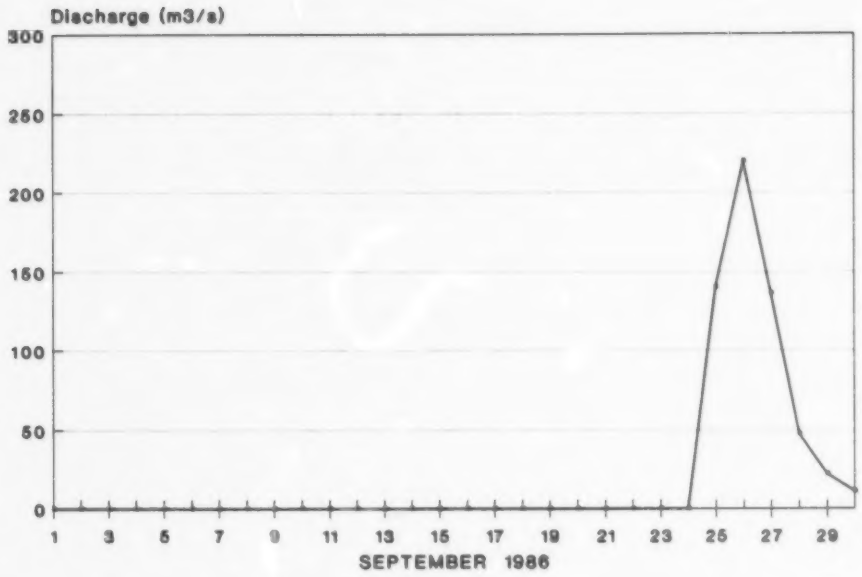
PERIOD OF RECORD: Established in 1952 the station replaced the then existing station (NO. 11AB006) which was located above the McRae-Lodge Creeks confluence. The original station operated from 1911 to 1951 during open water seasons.

RECORDED MAXIMUMS: The largest recorded instantaneous flows are 280 m3/s (19:00 CST Sept.25, 1986) and 220 m3/s (10:00 MST June 14, 1962). The two largest daily recorded flows are 220 m3/s (Sept.26, 1986) and 140 m3/s (Apr.14, 1952). The maximum daily flow recorded at the original upstream station (No. 11AB006), which had a drainage area of 1970 km2, is 121 m3/s (Mar.30 1943).

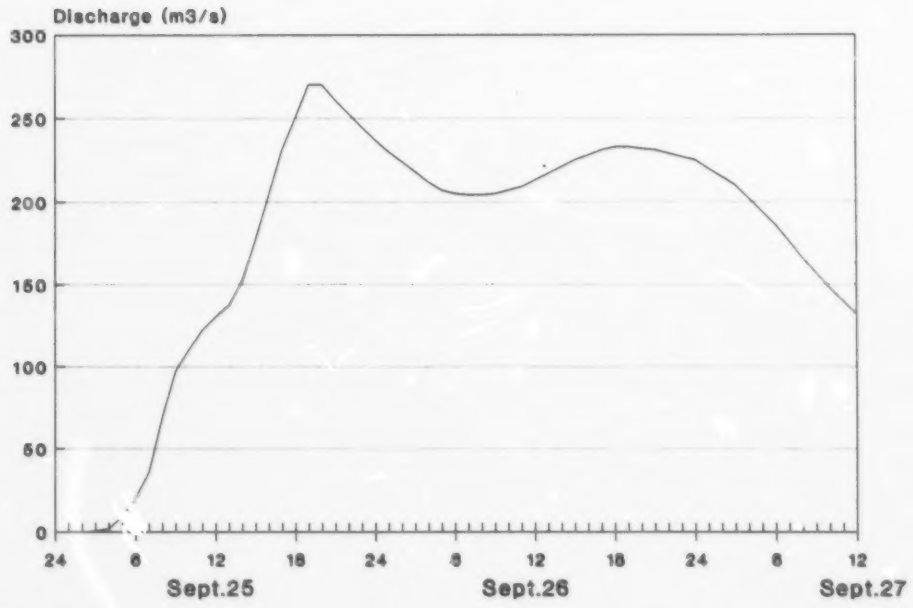
HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
Lodge Creek at International Boundary
(11AB083)



HYDROGRAPH OF HOURLY DISCHARGE
Lodge Creek at U.S. Boundary
(11AB083)



WATER SURVEY OF CANADA
OCT 01 1988 PAGE 8871
REGINA, SASK.

LODGE CREEK BELOW MCRAE CREEK AT INTERNATIONAL BOUNDARY

STATION NO. 11AB083

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	0 B	24.4 B	0.977	0.117	0.244	0.009	0	0	7.05	---	---	1
2	---	0 B	38.5 B	0.882	0.116	0.178	0.006	0	0	5.20	---	---	2
3	---	0 B	35.5 B	0.829	0.114	0.148	0.004	0	0	4.32	---	---	3
4	---	0 B	23.6 B	0.692	0.120	0.129	0.002	0	0	4.19	---	---	4
5	---	0 B	12.3 B	0.591	0.145	0.110	0.002	0	0	3.91	---	---	5
6	---	0 B	8.90 B	0.505	0.140	0.112	0.001	0.029	0	3.23	---	---	6
7	---	0 B	6.40 B	0.454	0.137	0.160	0.001	0.020	0	2.40	---	---	7
8	---	0 B	4.10 B	0.477	0.156	0.235	0.001	0.013	0	1.92	---	---	8
9	---	0 B	3.52 B	0.404	0.167	0.251	0.001	0.006	0	1.51	---	---	9
10	---	0 B	3.11 B	0.316	0.164	0.206	0	0.004	0	1.21	---	---	10
11	---	0 B	2.18 B	0.269	0.481	0.137	0	0.002	0	1.08	---	---	11
12	---	0 B	1.77 B	0.279	2.85	0.105	0	0.002	0	0.840	---	---	12
13	---	0 B	1.44 B	0.304	0.739	0.092	0	0.001	0	0.739	---	---	13
14	---	0 B	1.17 B	0.254	0.609	0.068	0	0.001	0	0.708	---	---	14
15	---	0 B	1.56 B	0.235	0.497	0.056	0	0.001	0	0.677	---	---	15
16	---	0 B	1.95 B	0.190	0.517	0.046	0	0	0	0.628	---	---	16
17	---	0 B	1.40 B	0.171	0.560	0.040	1.54	0	0	0.624	---	---	17
18	---	0 B	0.805	0.164	0.400	0.037	0.324	0	0	0.573	---	---	18
19	---	0 B	0.628	0.155	0.358	0.061	0.100	0	0.001	0.526	---	---	19
20	---	0 B	0.538	0.169	1.12	0.122	0.043	0	0.033	0.493	---	---	20
21	---	0 B	0.509	0.169	2.18	0.107	0.025	0	0.034	0.458	---	---	21
22	---	0 B	1.78	0.156	3.44	0.070	0.016	0	0.017	0.424	---	---	22
23	---	0 B	2.67	0.130	4.40	0.047	0.014	0	0.009	0.421	---	---	23
24	---	0 B	3.34	0.114	4.08	0.032	0.010	0	0.005	0.393	---	---	24
25	---	0 B	3.02	0.151	4.58	0.022	0.006	0	140	0.364	---	---	25
26	---	0.047B	2.29	0.360	3.84	0.016	0.004	0	220	0.348	---	---	26
27	---	2.77 B	1.58	0.212	2.94	0.012	0.002	0	136	0.339	---	---	27
28	---	12.4 B	1.25	0.151	1.79	0.007	0.002	0	47.3	0.313	---	---	28
29	---		1.07	0.134	0.970	0.009	0.001	0	21.8	0.313	---	---	29
30	---		0.913	0.122	0.582	0.011	0 001	0	10.8	0.327	---	---	30
31	---		0.823		0.370		0	0		0.313E		---	31
TOTAL	---	15.217	193.016	10.016	38.679	2.870	2.215	0.079	575.999	45.341	---	---	TOTAL
MEAN	---	0.543	6.23	0.334	1.25	0.096	0.071	0.003	19.2	1.48	---	---	MEAN
MAX	---	12.4	38.5	0.977	4.58	0.251	1.64	0.029	220	7.05	---	---	MAX
MIN	---	0	0.509	0.114	0.114	0.007	0	0	0	0.313	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 3.55
MAXIMUM DAILY, 220 ON SEP 26
MINIMUM DAILY, 0 ON JUL 10
MAXIMUM INSTANTANEOUS,
280 AT 19:00 CST ON SEP 25

MONTHLY TOTAL DISCHARGE IN CUBIC DECAMETRES

JAN	---	JUL	191
FEB	1 310	AUG	6.83
MAR	16 700	SEP	49 800
APR	865	OCT	3 960
MAY	3 340	NOV	---
JUN	248	DEC	---

TOTAL DISCHARGE, 75 100 DAM3

B - ICE CONDITIONS
E - ESTIMATED

LODGE CREEK BELOW MCRAE CREEK AT INTERNATIONAL BOUNDARY

STATION NO. 11AB083

GAUGE HEIGHTS IN THOUSANDTHS OF METRES AND DISCHARGES IN M3/S EVERY HOUR

MONTH	DAY	YEAR	TIME	GAUGE HT	DISCHARGE	GAUGE HT	DISCHARGE	GAUGE HT	DISCHARGE	GAUGE HT	DISCHARGE	TIME
SEP	24	1986	1-00	436	0.006	435	0.005	434	0.005	434	0.005	4-00
			5-00	433	0.005	432	0.005	432	0.005	431	0.005	8-00
			9-00	430	0.005	430	0.005	429	0.005	428	0.005	12-00
			13-00	428	0.005	427	0.005	426	0.005	425	0.005	16-00
			17-00	424	0.004	423	0.004	423	0.004	423	0.004	20-00
			21-00	431	0.005	442	0.006	454	0.009	472	0.012	24-00
SEP	25	1986	1-00	495	0.017	598	0.054	771	0.391	1015	2.020	4-00
			5-00	1510	9.270	2026	20.200	2556	35.900	3248	69.200	8-00
			9-00	3635	97.100	3785	110.000	3909	122.000	3984	130.000	12-00
			13-00	4051	137.000	4185	152.000	4377	177.000	4569	204.000	16-00
			17-00	4731	231.000	4840	250.000	4949	270.000	4931	270.000	20-00
			21-00	4904	261.000	4857	253.000	4812	245.000	4771	237.000	24-00
SEP	26	1986	1-00	4729	230.000	4690	224.000	4653	218.000	4615	212.000	4-00
			5-00	4589	207.000	4572	205.000	4565	204.000	4564	204.000	8-00
			9-00	4570	205.000	4585	207.000	4601	209.000	4623	213.000	12-00
			13-00	4648	217.000	4673	221.000	4698	225.000	4717	228.000	16-00
			17-00	4734	231.000	4744	233.000	4744	233.000	4738	232.000	20-00
			21-00	4732	231.000	4722	229.000	4711	227.000	4696	225.000	24-00
SEP	27	1986	1-00	4669	220.000	4635	215.000	4602	210.000	4554	202.000	4-00
			5-00	4497	194.000	4440	186.000	4370	176.000	4299	166.000	8-00
			9-00	4228	157.000	4153	148.000	4078	140.000	4004	132.000	12-00
			13-00	3931	124.000	3861	117.000	3795	111.000	3727	105.000	16-00
			17-00	3653	98.600	3579	92.500	3505	86.800	3430	81.400	20-00
			21-00	3358	76.400	3310	73.100	3261	70.100	3213	67.000	24-00
SEP	28	1986	1-00	3173	64.600	3141	62.800	3109	61.000	3077	59.200	4-00
			5-00	3045	57.500	3014	55.800	2984	54.300	2955	52.900	8-00
			9-00	2925	51.400	2896	50.000	2867	48.700	2840	47.400	12-00
			13-00	2812	46.100	2784	44.900	2756	43.700	2728	42.600	16-00
			17-00	2699	41.400	2670	40.200	2642	39.100	2613	38.000	20-00
			21-00	2583	36.900	2551	35.700	2519	34.600	2491	33.600	24-00
SEP	29	1986	1-00	2455	32.400	2420	31.300	2388	30.200	2355	29.300	4-00
			5-00	2323	28.300	2290	27.300	2255	26.300	2220	25.400	8-00
			9-00	2185	24.400	2152	23.500	2119	22.600	2084	21.700	12-00
			13-00	2052	20.900	2026	20.200	1999	19.500	1972	18.800	16-00
			17-00	1946	18.200	1919	17.600	1893	16.900	1868	16.400	20-00
			21-00	1845	15.800	1822	15.300	1800	14.800	1782	14.400	24-00
SEP	30	1986	1-00	1763	14.000	1744	13.600	1726	13.200	1709	12.900	4-00
			5-00	1692	12.600	1676	12.300	1660	11.900	1644	11.600	8-00
			9-00	1630	11.400	1617	11.100	1604	10.900	1590	10.600	12-00
			13-00	1577	10.400	1564	10.200	1554	10.000	1543	9.830	16-00
			17-00	1532	9.640	1521	9.450	1510	9.270	1500	9.100	20-00
			21-00	1490	8.940	1480	8.780	1470	8.620	1460	8.460	24-00

BATTLE CREEK AT ALBERTA BOUNDARY
(11AB117)

LOCATION: LAT. 49-38-55 N. LONG. 110-00-15 W., on west side of Battle Creek in Sec.16 Twp.8 Rge.30 W3rd.Mer. approximately 34 km south and 3 km east of Walsh, Alberta.

DRAINAGE AREA: 111 km2

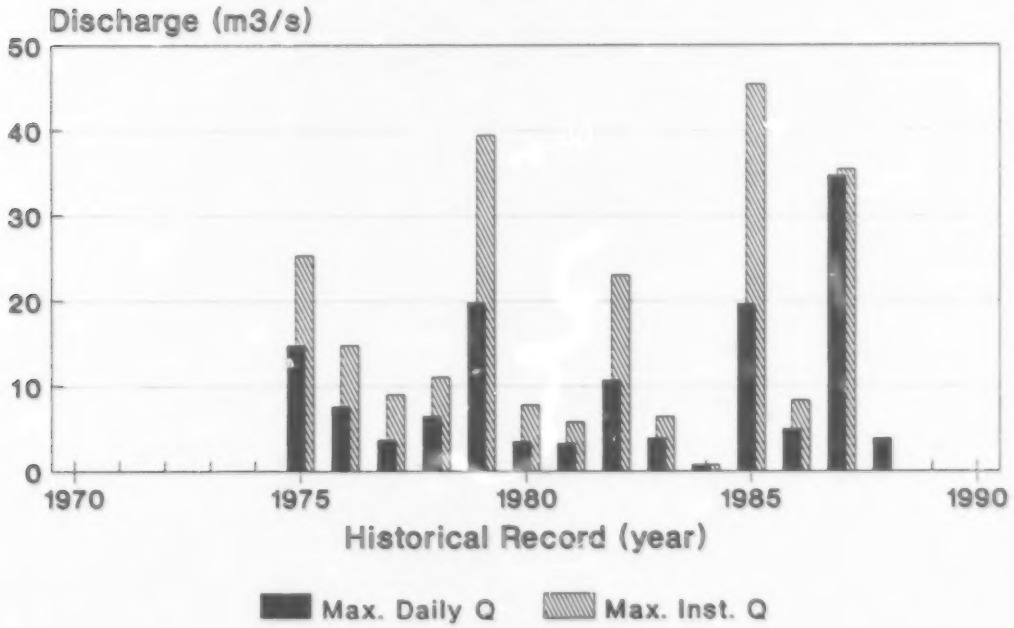
STAGE RECORD: Float activated recorder in standard shelter with data collection platform and Memomark 3 system.

DISCHARGE RECORD: Stage-discharge relationship determined by wading and cableway measurements.

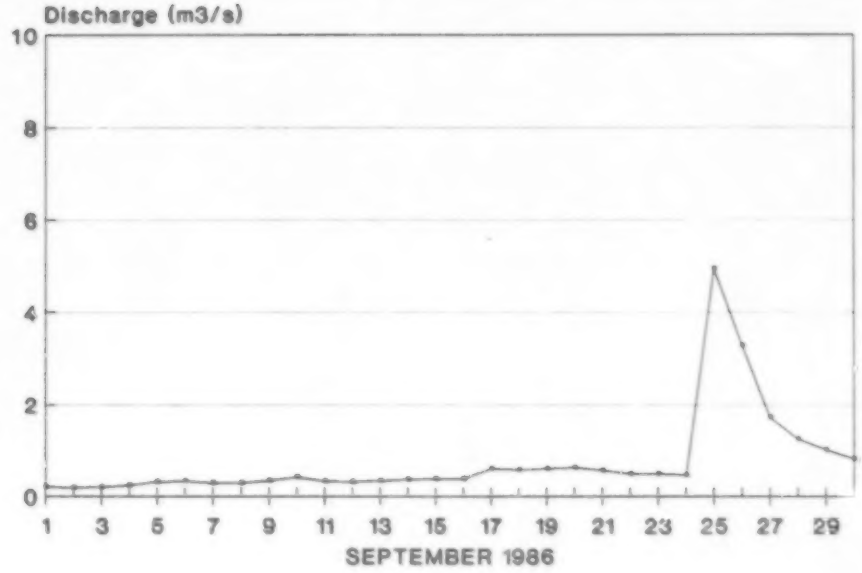
PERIOD OF RECORD: 1975 to present for open water seasons.

RECORDED MAXIMUMS: Maximum instantaneous recorded flow is 45.4 m3/s (22:06 CST Apr.28,1985) with a maximum daily flow of 19.8 m3/s (Apr.17, 1979). The next largest flows for the above are 39.4 m3/s (Apr.17, 1979) and 19.6 m3/s (Apr.13,1985), respectively. Maximum daily flow reached during the storm was 4.95 m3/s (Sept.25, 1986). The maximum instantaneous flow recorded in 1986 was 8.29 m3/s and occurred on Feb.26 during runoff.

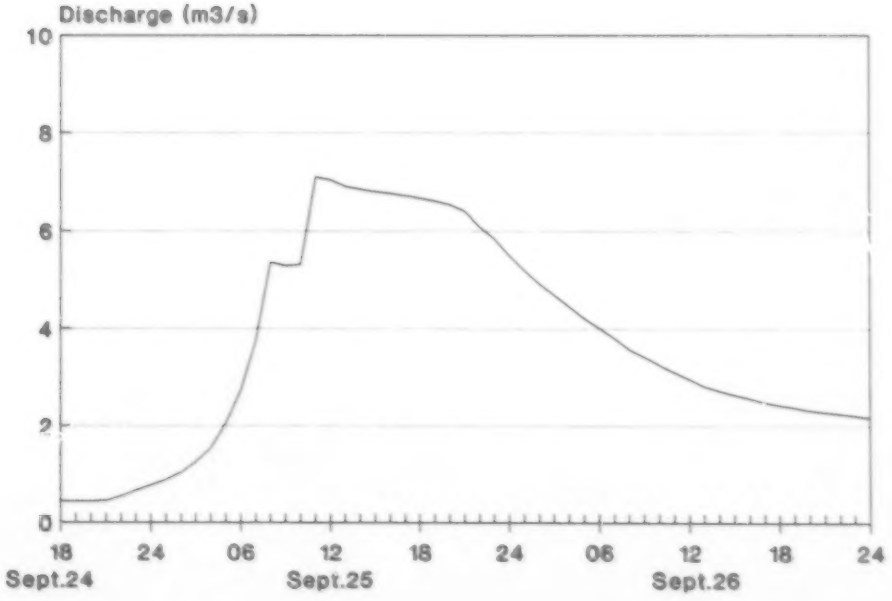
HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
Battle Creek at Alberta Boundary
(11AB117)



HYDROGRAPH OF HOURLY DISCHARGE
Battle Creek at Alberta Boundary
(11AB117)



NATURAL DAILY FLOW ESTIMATION

SEPTEMBER, 1986

BATTLE CREEK AT ALBERTA BOUNDARY

STATION 11AB117

A single small reservoir (Reesor) is the only control upstream of station 11AB117. The drainage area of the reservoir represents only 3% of the GDA at station 11AB117. As the effects are considered to be small the flows recorded at the station are considered to be indicative of natural runoff and no adjustment was done on recorded values. Frequency analysis indicates that the September 1986 flows have a return period of approximately 1.3 years. The maximum daily flow during the flood was 4.95 m^3/s (September, 25).

WATER SURVEY OF CANADA
OCT 01 1988 PAGE 9291
REGINA, SASK.

BATTLE CREEK AT ALBERTA BOUNDARY

STATION NO. 11AB117

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	0.062B	1.94 B	0.562	0.221	0.632	0.258	0.211	0.197	0.712	---	---	1
2	---	0.062B	1.01 B	0.449	0.202	0.599	0.211	0.210	0.193	0.702	---	---	2
3	---	0.061B	0.665B	0.356	0.191	0.575	0.166	0.204	0.199	0.673	---	---	3
4	---	0.061B	0.178B	0.329	0.329	0.544	0.160	0.194	0.240	0.632	---	---	4
5	---	0.060B	0.521B	0.332	1.14	0.536	0.171	0.185	0.311	0.606	---	---	5
6	---	0.060B	0.667B	0.340	0.938	0.546	0.197	0.188	0.324	0.593	---	---	6
7	---	0.060B	0.584	0.325	0.918	0.618	0.215	0.196	0.288	0.541	---	---	7
8	---	0.059B	0.594	0.298	0.787	0.685	0.206	0.197	0.292	0.543	---	---	8
9	---	0.059B	0.542	0.317	0.761	0.765	0.189	0.202	0.339	0.546	---	---	9
10	---	0.058B	0.509	0.339	0.876	0.724	0.185	0.207	0.419	0.560	---	---	10
11	---	0.058B	0.404	0.297	0.990	0.623	0.169	0.204	0.322	0.399	---	---	11
12	---	0.057B	0.369	0.247	1.00	0.550	0.178	0.189	0.315	0.369	---	---	12
13	---	0.057B	0.380	0.253	0.846	0.536	0.205	0.182	0.342	0.353	---	---	13
14	---	0.056B	0.603	0.282	0.819	0.521	0.214	0.184	0.365	0.347	---	---	14
15	---	0.056B	0.983	0.308	0.900	0.557	0.166	0.180	0.378	0.378	---	---	15
16	---	0.055B	1.06	0.281	0.835	0.613	0.153	0.175	0.373	0.391	---	---	16
17	---	0.055B	1.07	0.279	1.01	0.573	0.419	0.173	0.600	0.394	---	---	17
18	---	0.054B	0.458	0.246	1.12	0.584	0.454	0.175	0.573	0.382	---	---	18
19	---	0.054B	0.173	0.219	1.29	0.560	0.360	0.168	0.605	0.368	---	---	19
20	---	0.053B	0.152	0.228	1.57	0.482	0.315	0.167	0.622	0.366	---	---	20
21	---	0.052B	0.256	0.244	1.50	0.341	0.293	0.163	0.363	0.369	---	---	21
22	---	0.051B	0.555	0.277	1.44	0.311	0.286	0.164	0.489	0.368	---	---	22
23	---	0.050B	0.419	0.337	1.69	0.295	0.282	0.167	0.488	0.367	---	---	23
24	---	0.350B	0.326	0.380	1.54	0.279	0.286	0.165	0.467	0.364	---	---	24
25	---	1.06 B	0.372	0.367	1.26	0.263	0.250	0.166	4.95	0.357	---	---	25
26	---	5.68 B	0.275	0.376	1.11	0.252	0.217	0.175	3.28	0.358	---	---	26
27	---	2.92 B	0.449	0.348	0.995	0.228	0.206	0.151	1.72	0.359	---	---	27
28	---	1.80 B	0.918	0.304	0.895	0.219	0.207	0.181	1.25	0.349A	---	---	28
29	---		0.940	0.259	0.810	0.208	0.206	0.185	1.01	0.348E	---	---	29
30	---		0.742	0.239	0.748	0.252	0.208	0.171	0.816	0.348E	---	---	30
31	---		0.738		0.687		0.211	0.189		0.347E		---	31
TOTAL	---	13.120	18.852	9.418	29.418	14.471	7.243	5.668	22.330	13.789	---	---	TOTAL
MEAN	---	0.469	0.608	0.314	0.949	0.482	0.234	0.183	0.744	0.445	---	---	MEAN
MAX	---	5.68	1.94	0.562	1.69	0.765	0.454	0.211	4.95	0.712	---	---	MAX
MIN	---	0.050	0.152	0.219	0.191	0.208	0.153	0.151	0.193	0.347	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0.495
MAXIMUM DAILY, 4.95 ON SEP 25
MINIMUM DAILY, 0.151 ON AUG 27
MAXIMUM INSTANTANEOUS,
8.298 AT 02:57 CST ON FEB 26

A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED

MONTHLY TOTAL DISCHARGE IN CUBIC DECAMETRES

JAN	---	JUL	626
FEB	1 130	AUG	490
MAR	1 630	SEP	1 930
APR	814	OCT	1 190
MAY	2 540	NOV	---
JUN	1 250	DEC	---

TOTAL DISCHARGE, 10 500 DAM3

BATTLE CREEK AT ALBERTA BOUNDARY

STATION NO. 11AB117

MONTH	DAY	YEAR	TIME	DISCHARGES IN M3/S EVERY HOUR								TIME
SEP	21	1986	1-00	0.591	0.593	0.594	0.594	0.590	0.586	0.583	0.581	8-00
			9-00	0.578	0.575	0.572	0.568	0.564	0.561	0.558	0.552	16-00
			17-00	0.545	0.539	0.535	0.531	0.528	0.524	0.519	0.514	24-00
SEP	22	1986	1-00	0.509	0.505	0.501	0.497	0.494	0.492	0.489	0.486	8-00
			9-00	0.483	0.480	0.477	0.474	0.471	0.470	0.469	0.467	16-00
			17-00	0.465	0.464	0.465	0.488	0.518	0.529	0.532	0.532	24-00
SEP	23	1986	1-00	0.527	0.521	0.518	0.515	0.500	0.493	0.489	0.483	8-00
			9-00	0.481	0.484	0.488	0.485	0.482	0.480	0.478	0.478	16-00
			17-00	0.477	0.477	0.476	0.473	0.469	0.467	0.466	0.465	24-00
SEP	24	1986	1-00	0.464	0.463	0.461	0.456	0.452	0.444	0.441	0.441	8-00
			9-00	0.441	0.441	0.441	0.441	0.441	0.442	0.443	0.444	16-00
			17-00	0.444	0.444	0.444	0.445	0.452	0.546	0.667	0.780	24-00
SEP	25	1986	1-00	0.891	1.040	1.250	1.540	2.050	2.740	3.760	5.360	8-00
			9-00	5.290	5.310	7.090	7.040	6.910	6.840	6.800	6.760	16-00
			17-00	6.720	6.670	6.610	6.540	6.410	6.080	5.850	5.500	24-00
SEP	26	1986	1-00	5.190	4.920	4.690	4.450	4.220	4.010	3.810	3.590	8-00
			9-00	3.430	3.260	3.110	2.970	2.820	2.730	2.650	2.570	16-00
			17-00	2.490	2.430	2.380	2.330	2.290	2.250	2.220	2.170	24-00
SEP	27	1986	1-00	2.130	2.060	2.000	1.960	1.920	1.880	1.840	1.800	8-00
			9-00	1.770	1.740	1.710	1.690	1.660	1.640	1.610	1.580	16-00
			17-00	1.560	1.550	1.530	1.510	1.490	1.480	1.470	1.450	24-00
SEP	28	1986	1-00	1.440	1.420	1.400	1.370	1.340	1.320	1.300	1.280	8-00
			9-00	1.270	1.260	1.250	1.240	1.230	1.220	1.210	1.200	16-00
			17-00	1.190	1.180	1.170	1.160	1.140	1.130	1.120	1.100	24-00
SEP	29	1986	1-00	1.090	1.080	1.080	1.070	1.060	1.050	1.040	1.040	8-00
			9-00	1.030	1.020	1.010	1.010	1.000	0.995	0.990	0.984	16-00
			17-00	0.978	0.973	0.966	0.952	0.936	0.918	0.904	0.893	24-00
SEP	30	1986	1-00	0.884	0.876	0.867	0.858	0.853	0.847	0.842	0.837	8-00
			9-00	0.832	0.825	0.818	0.811	0.804	0.801	0.798	0.794	16-00
			17-00	0.791	0.786	0.780	0.773	0.768	0.762	0.757	0.750	24-00
OCT	1	1986	1-00	0.744	0.737	0.734	0.731	0.729	0.725	0.722	0.719	8-00
			9-00	0.716	0.713	0.710	0.706	0.704	0.702	0.700	0.698	16-00
			17-00	0.696	0.696	0.697	0.698	0.698	0.697	0.695	0.693	24-00
OCT	2	1986	1-00	0.691	0.689	0.688	0.688	0.688	0.689	0.692	0.694	8-00
			9-00	0.695	0.695	0.697	0.700	0.703	0.707	0.710	0.712	16-00
			17-00	0.713	0.714	0.714	0.714	0.715	0.716	0.718	0.720	24-00

FREQUENCY ANALYSIS - LOG PEARSON TYPE III DISTRIBUTION
11AB117 BATTLE CREEK AT ALBERTA BOUNDRY

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	17.156	14.500	0.845	1.025	4.156
LN X SERIES	2.415	1.135	0.470	-1.170	6.484

X(MIN)= 0.769
X(MAX)= 45.400
LOWER OUTLIER LIMIT OF X= 1.045

TOTAL SAMPLE SIZE= 11
NO. OF LOW OUTLIERS= 1
NO. OF ZERO FLOWS= 0

AFTER REMOVAL OF ZEROES AND/OR LOW OUTLIERS

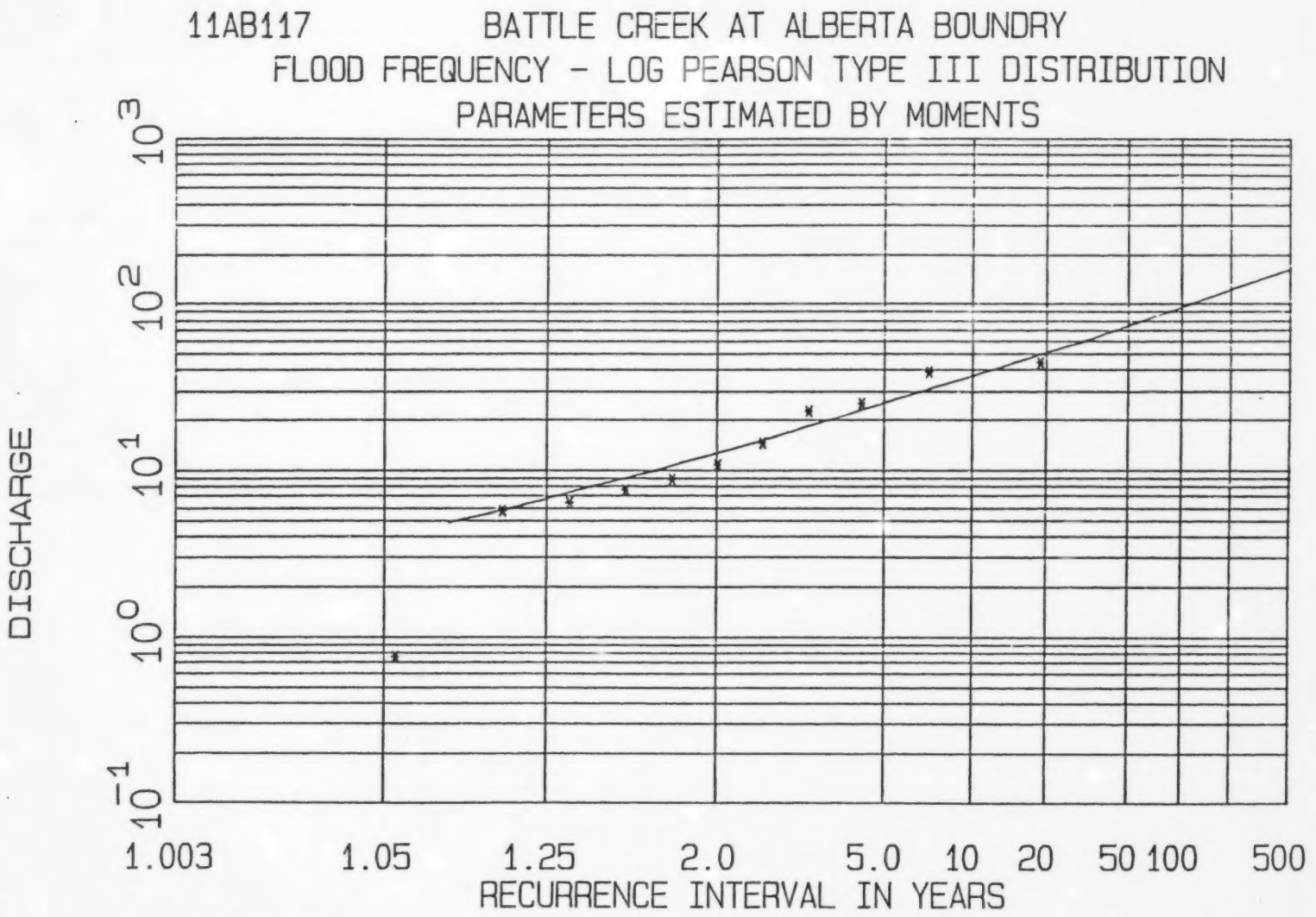
	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	18.795	14.170	0.754	1.028	4.129
LN X SERIES	2.682	0.746	0.278	0.326	2.919

SOLUTION OBTAINED VIA MOMENTS

PARAMETERS OF THE LP3 WHICH DUPLICATES THE CONDITIONAL FUNCTION:
A= 0.1088 B= 51.54 LOG(M)= -3.020 M = 0.4880E-01
SYNTHETIC STATISTICS: MEAN= 2.586 S.D.= 0.781 C.S.= 0.279

FLOOD FREQUENCY REGIME

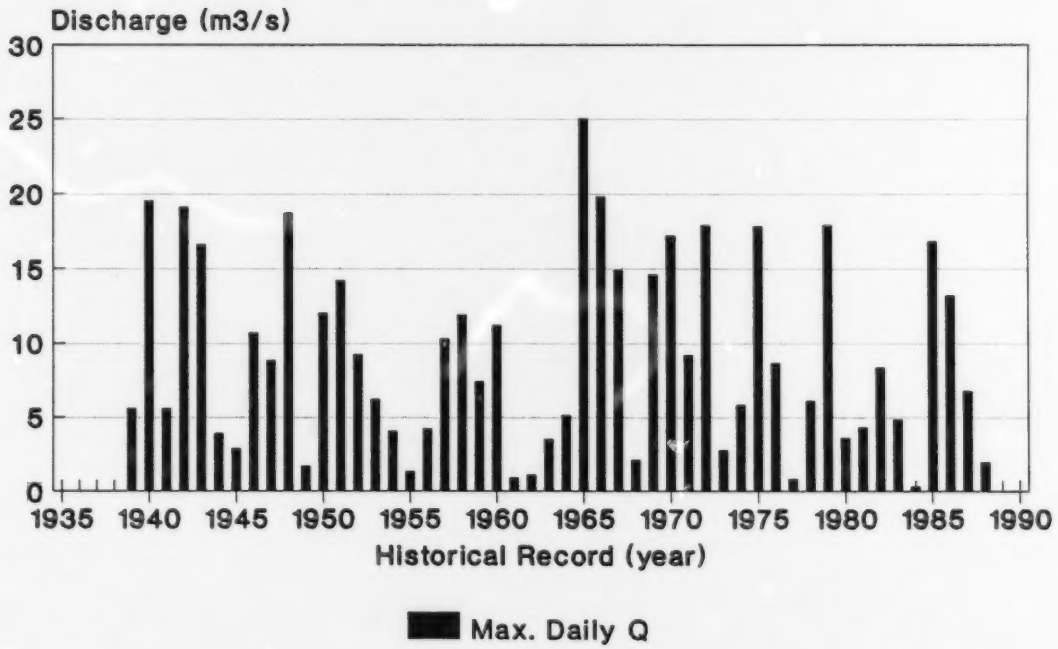
RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	0.997	-
1.050	0.952	-
1.250	0.800	6.83
2.000	0.500	12.80
5.000	0.200	25.30
10.000	0.100	36.80
20.000	0.050	50.90
50.000	0.020	74.00
100.000	0.010	95.70
200.000	0.005	122.00
500.000	0.002	164.00


11AB117 BATTLE CREEK AT ALBERTA BOUNDRY
FLOOD FREQUENCY - LOG PEARSON TYPE III DISTRIBUTION
PARAMETERS ESTIMATED BY MOMENTS
DISCHARGE
10^3
10^2
10^1
10^0
10^{-1}
1.003
1.05
1.25
2.0
5.0
10
20
50
100
500
RECURRENCE INTERVAL IN YEARS

CYPRESS LAKE WEST INFLOW CANAL
(11AB078)

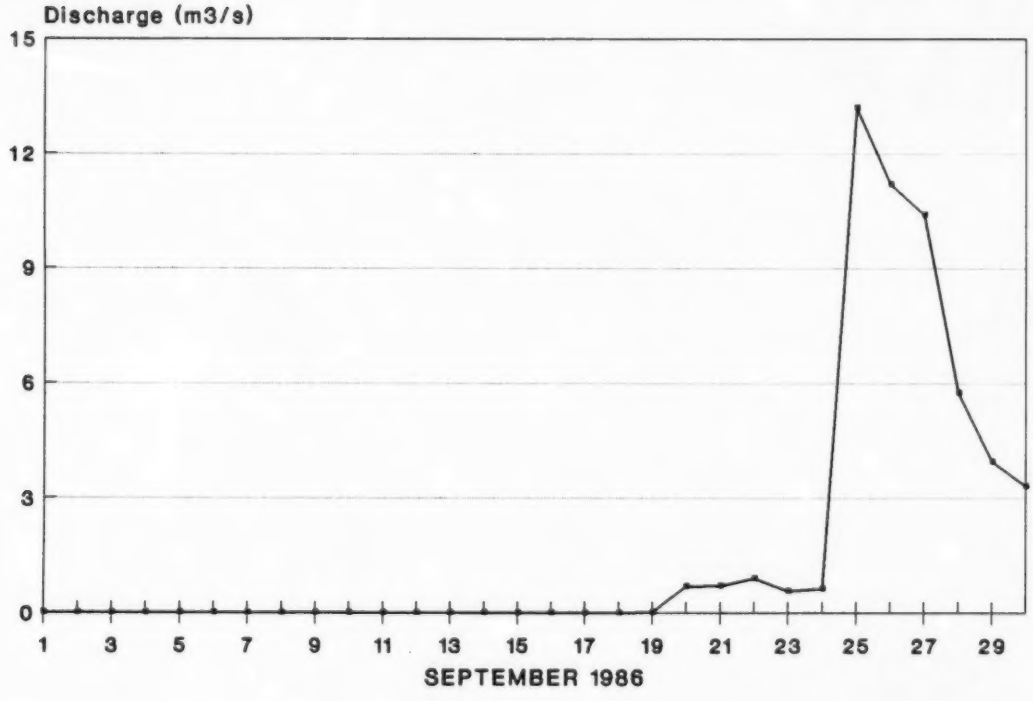
LOCATION: LAT.49-28-25 N. LONG. 109-36-38 W., NW1/4 Sec. 17 Twp.6 Rge.27 W.3rd.Mer. approximately 22.5 km north and 6.4 km west of Consul, Sask.
DRAINAGE AREA:
STAGE RECORD: Float activated recorder in a standard shelter
DISCHARGE RECORD: Stage-discharge relationship determined using wading and walkway measurements.
PERIOD OF RECORD: 1939 to present for open water seasons.
RECORDED MAXIMUMS: Maximum instantaneous discharges have not been determined for this station. The maximum recorded daily flow is 25.0 m3/s (Apr. 27,1965). The next largest flow of 19.8 m3/s occurred Mar 31, 1966. The storm of Sept. 1986 produced a daily flow of 13.2 m3/s (Sept.25,1986).

HISTORICAL MAXIMUMS
DAILY DISCHARGE



HYDROGRAPH OF DAILY DISCHARGE

Cypress Lake West Inflow Canal
(11AB078)



WATER SURVEY OF CANADA
OCT 01 1988 PAGE 3774
REGINA, SASK.

CYPRESS LAKE WEST INFLOW CANAL

STATION NO. 11AB078

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	0 B	11.7 B	0.005	0.347	0.775	0.039	0.010	0	2.87	0	---	1
2	---	0 B	9.59 B	0.004	0.327	0.890	0.032	0.010	0	2.56	0	---	2
3	---	0 B	7.48 B	0.004	0.334	0.812	0.023	0.010	0	2.33	0	---	3
4	---	0 B	5.35 B	0.003	0.349	0.683	0.018	0.011	0	2.21	0A	---	4
5	---	0 B	5.61 B	0.002	0.443	0.593	0.015	0.011	0	2.06	---	---	5
6	---	0 B	4.31 B	0.002	0.717	0.355	0.014	0.010	0	1.97	---	---	6
7	---	0 B	5.96 B	0.001	1.61	0.022	0.012	0.009	0	1.91	---	---	7
8	---	0 B	4.08 B	0	1.42	0.012	0.011	0.009	0	1.86	---	---	8
9	---	0 B	2.92 B	0	1.41	0.008	0.011	0.009	0	1.82	---	---	9
10	---	0 B	3.13 B	0	1.24	0.530	0.011	0.009	0	1.79	---	---	10
11	---	0 B	3.06 B	0.455	1.25	0.748	0.012	0.009	0	1.72	---	---	11
12	---	0 B	2.90 B	0.546	1.48	0.477	0.011	0.008	0	1.70	---	---	12
13	---	0 B	2.14 B	0.641B	1.65	0.139	0.010	0.008	0	1.54	---	---	13
14	---	0 B	2.29 B	0.665B	1.57	0.140	0.010	0.007	0	1.36	---	---	14
15	---	0 B	2.11 B	0.741B	1.55	0.146	0.010	0.006	0	1.30	---	---	15
16	---	0 B	1.80 B	0.781B	1.71	0.137	1.38	0.005	0	1.26	---	---	16
17	---	0 B	1.59 B	0.881B	1.86	0.143	1.02	0.005	0	0.818	---	---	17
18	---	0 B	1.37 B	0.733B	1.99	0.184	1.03	0.004	0	0.022	---	---	18
19	---	0 B	0.807B	0.740	2.17	0.395	0.973	0.002	0.014	0.014	---	---	19
20	---	0 B	0.237B	0.639	2.29	0.417	0.966	0	0.700	0.010	---	---	20
21	---	0 B	0.154B	0.461	2.94	0.438	0.611	0	0.711	0.009	---	---	21
22	---	0 B	0.129B	0.383	3.03	0.446	0.055	0	0.905A	0.008	---	---	22
23	---	0 B	0.059	0.330	4.03	0.422	0.032	0	0.578	0.007	---	---	23
24	---	0 B	0.044	0.358	4.33	0.283	0.028	0	0.635	0.006	---	---	24
25	---	2.01B	0.034	0.388	3.43	0.294	0.020	0	13.2 A	0.003	---	---	25
26	---	7.97B	0.025	0.388	2.61	0.321	0.019	0	11.2 E	0.001	---	---	26
27	---	9.65B	0.070	0.355	2.17	0.324	0.019	0	10.4 A	0.001	---	---	27
28	---	11.1 B	0.097	0.437	1.83	0.203	0.016	0	5.73	0.001	---	---	28
29	---		0.073	0.401	1.60	0.203	0.012	0	3.95	0	---	---	29
30	---		0.012	0.375	1.28	0.098	0.009	0	3.31	0.001	---	---	30
31	---		0.007		1.06		0.009	0		0		---	31
TOTAL	---	30.73	79.138	10.719	54.027	10.638	6.438	0.152	51.333	31.161	---	---	TOTAL
MEAN	---	1.10	2.55	0.357	1.74	0.355	0.208	0.005	1.71	1.01	---	---	MEAN
MAX	---	11.1	11.7	0.881	4.33	0.890	1.38	0.011	13.2	2.87	---	---	MAX
MIN	---	0	0.007	0	0.327	0.008	0.009	0	0	0	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0.994
MAXIMUM DAILY, 13.2A ON SEP 25
MINIMUM DAILY, 0 ON APR 8

A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED

MONTHLY TOTAL DISCHARGE IN CUBIC DECAMETRES

JAN	---	JUL	556
FEB	2 660	AUG	13.1
MAR	6 840	SEP	4 440
APR	926	OCT	2 690
MAY	4 670	NOV	---
JUN	919	DEC	---

TOTAL DISCHARGE, 21 100 DAM3

BATTLE CREEK BELOW WILSON'S WEIR
(11AB118)

LOCATION: LAT. 49-27-01 N. LONG. 109-38-39 W. NE1/4 Sec.1 Twp.6 Rge.28 W3rd.Mer. approximately 17.6 km north of Consul on grid road and 8 km west.

DRAINAGE AREA:

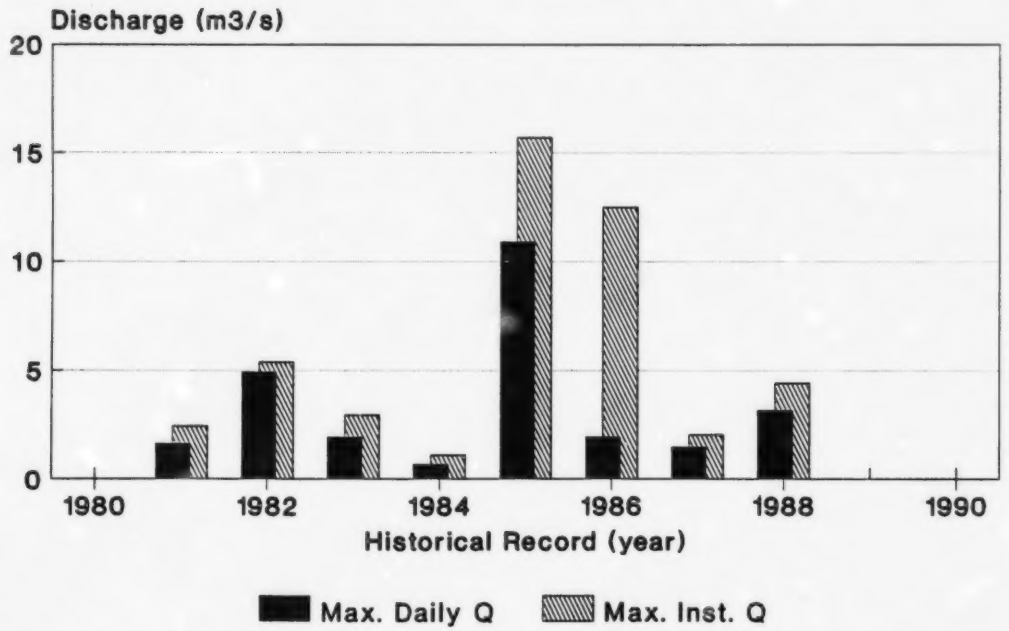
STAGE RECORD:Float activated recorder in a standard shelter.

DISCHARGE RECORD: Stage-discharge relationship determined by wading at metering section 400 m below weir control.

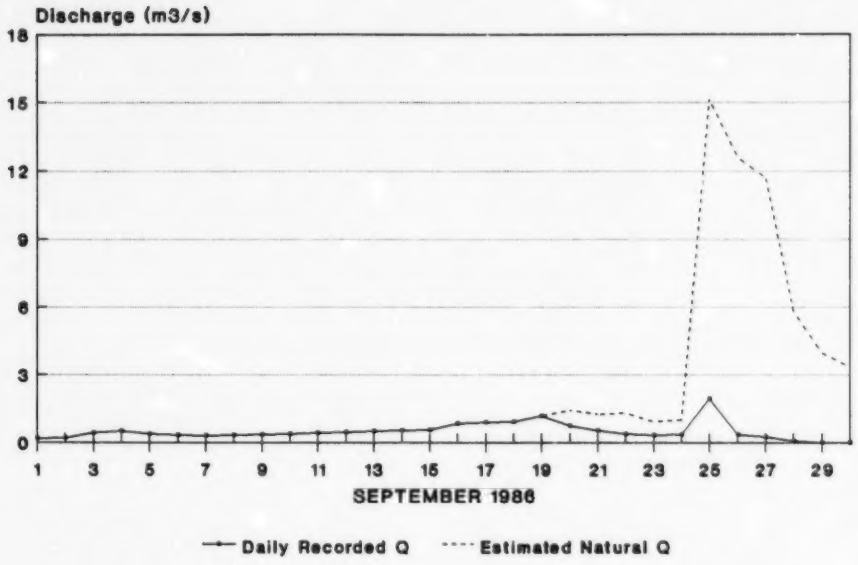
PERIOD OF RECORD: 1980 to present for open water seasons.

RECORDED MAXIMUMS: Maximum instantaneous recorded discharge is 15.7 m3/s (01:25 CST Apr.30, 1985) with a previous high of 5.38 m3/s (06:13 CST June 5,1982). Maximum daily discharges recorded on the same dates were 10.9 m3/s and 4.91 m3/s respectively. The station was not within the full intensity of the September 1986 storm as the maximum daily flow was only 1.93 m3/s on Sept. 25, 1986. The maximum instantaneous flow in 1986 occurred on Feb. 27 (12.5 m3/s).

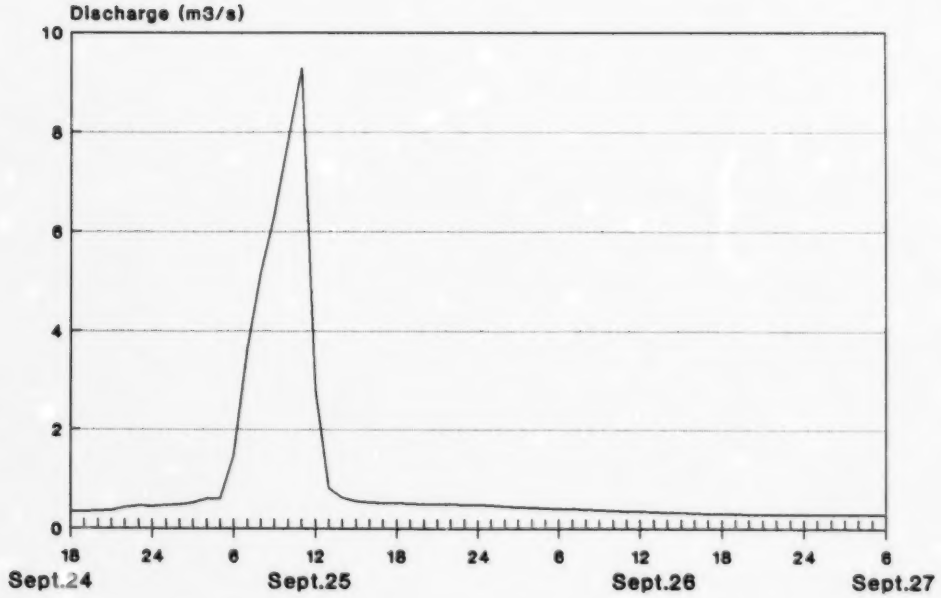
HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
Battle Creek Below Wilson's Weir
(11AB118)



HYDROGRAPH OF HOURLY DISCHARGE
Battle Creek Below Wilson's Weir
(11AB118)



NATURAL DAILY FLOW ESTIMATIONS

SEPTEMBER 1986

BATTLE CREEK BELOW WILSON'S WEIR

STATION 11AB118

At the time of the flood, diversion was occurring upstream of 11AB118. Diversion waters, as measured by station Cypress Lake West Inflow Canal (11AB078), were being transferred from Battle Creek to Cypress Lake. There was negligible flow in Gaff and Shepherd Ditches. Adams Lake did affect the discharge in Battle Creek as storage took place during the flood period. The total amount of storage (as calculated in the report The Division of Waters of St. Mary and Milk Rivers) was 196 dam^3 from September 19 to September 28. This storage was almost totally accumulated during the two day rain storm of September 24, 25 with approximately 98 dam^3 stored each day. Channel loss from Adams Lake to the International Bcundary has previously been estimated as 14.7 dam^3/day. As lag between Adams Lake and Battle Creek below Wilson's Weir (11AB118) is approximately 2 days, and as the distance from Adam's Lake is to 11AB118 is approximately one-third of the total distance to the border, the channel losses were calculated as;

$$1/3 \times 14.7\ dam^3/day \times 2\ days = \underline{9.8\ dam^3}$$

The increase in flow at 11AB118, had storage not occurred, was therefore estimated to be;

$$98\ dam^3 - 9.8\ dam^3 = 88.2\ dam^3/day$$

which yields an average flow of 1.02 m^3/s. While the recessional characteristics are not known, for estimation purposes the transposed storage waters are said to have passed 11AB118 in a two day period. Flows on September 26, 27 were then increased by 1.02 m^3/s. Natural flow at 11AB118 was therefore calculated as;

$$\text{NATURAL } Q_{118} = \text{RECORDED } Q_{118} + \text{RECORDED } Q_{078} + (Q_{ADAMS} - \text{CH.LOSS})$$

WHERE Q118 = discharge at station Battle Creek below Wilson's Weir

Q078 = discharge at station Cypress Lake West Inflow Canal

QADAMS = estimated discharge from Adams Lake reservoir

The maximum daily flow estimated was 15.13 m^3/s (Sept. 25) which has a return period of approximately 2 years. The estimated maximum was 13.2 m^3/s higher than the recorded flow.

WATER SURVEY OF CANADA
OCT 01 1988 PAGE 9299
REGINA, SASK.

BATTLE CREEK BELOW WILSON'S WEIR

STATION NO. 11AB118

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	0.659B	1.53	0.006	0.006	0.562	0.324	0.199	0.008	0.722	---	1
2	---	---	0.030B	0.996	0.006	0.005	0.645	0.335	0.218	0.007	0.683	---	2
3	---	---	0.011B	0.827	0.008	0.005	0.493	0.339	0.447	0.007	1.00	---	3
4	---	---	0.011B	0.773	0.009	0.005	0.289	0.313	0.516	0.005	0.898A	---	4
5	---	---	0.010	0.643	0.010	0.006	0.269	0.292	0.391	0.005	---	---	5
6	---	---	0.009	0.600	0.008	0.012	0.242	0.282	0.349	0.005	---	---	6
7	---	---	0.007	0.481	0.008	0.289	0.292	0.308	0.325	0.005	---	---	7
8	---	---	0.008	0.459	0.008	0.759	0.380	0.307	0.335	0.005	---	---	8
9	---	---	0.008	0.407	0.012	0.847	0.374	0.343	0.363	0.005	---	---	9
10	---	---	0.010	0.349	0.011	0.266	0.237	0.337	0.389	0.005	---	---	10
11	---	---	0.007	0.234	0.011	0.094	0.213	0.319	0.435	0.008	---	---	11
12	---	---	0.006	0.005	0.011	0.085	0.234	0.307	0.467	0.004	---	---	12
13	---	---	0.006	0.004	0.010	0.350	0.319	0.305	0.514	0.001	---	---	13
14	---	---	0.006	0.006	0.012	0.222	0.380	0.313	0.542	0.001	---	---	14
15	---	---	0.009	0.004	0.012	0.186	0.413	0.285	0.561	0.001	---	---	15
16	---	---	0.007	0.008	0.010	0.191	0.842	0.244	0.851	0.001	---	---	16
17	---	---	0.008	0.003	0.010	0.345	0.594	0.247	0.893	0.123	---	---	17
18	---	---	0.008	0.007	0.010	0.409	0.019	0.245	0.921	0.805	---	---	18
19	---	---	0.256	0.005	0.010	0.327	0.008	0.225	1.17	1.06	---	---	19
20	---	---	0.837	0.005	0.010	0.300	0.007	0.205	0.731	1.04	---	---	20
21	---	---	0.942	0.006	0.010	0.156	0.008	0.189	0.536	1.02	---	---	21
22	---	---	0.797	0.005	0.018	0.081	0.131	0.195	0.393	1.03	---	---	22
23	---	---	0.874	0.006	0.013	0.046	0.442	0.197	0.335	0.977	---	---	23
24	---	---	0.930	0.005	0.012	0.043	0.568	0.187	0.359	0.962	---	---	24
25	---	0.329B	0.819	0.006	0.012	0.040	0.530	0.192	1.93	0.955	---	---	25
26	---	7.26 B	0.698	0.005	0.012	0.041	0.453	0.205	0.354	0.936	---	---	26
27	---	10.8 B	0.654	0.006	0.012	0.045	0.433	0.218	0.270	0.891	---	---	27
28	---	7.15 B	0.847	0.006	0.011	0.131	0.397	0.212	0.094	0.855	---	---	28
29	---		1.14	0.006	0.009	0.222	0.365	0.199	0.009	0.827	---	---	29
30	---		1.78	0.005	0.008	0.442	0.355	0.198	0.008	0.798	---	---	30
31	---		1.70		0.007		0.324	0.198		0.809		---	31
TOTAL	---	---	13.094	7.402	0.316	5.956	10.818	8.065	14.905	13.161	---	---	TOTAL
MEAN	---	---	0.422	0.247	0.010	0.199	0.349	0.260	0.497	0.425	---	---	MEAN
MAX	---	---	1.78	1.53	0.018	0.847	0.842	0.343	1.93	1.06	---	---	MAX
MIN	---	---	0.006	0.003	0.006	0.005	0.007	0.187	0.008	0.001	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0.301
MAXIMUM DAILY, 1.93 ON SEP 25
MINIMUM DAILY, 0.001 ON OCT 13
MAXIMUM INSTANTANEOUS,
12.58 AT 12:10 CST ON FEB 27

A - MANUAL GAUGE
B - ICE CONDITIONS

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	---	JUL	935
FEB	---	AUG	697
MAR	1 130	SEP	1 290
APR	640	OCT	1 140
MAY	27.3	NOV	---
JUN	515	DEC	---

TOTAL DISCHARGE, 6 370 DAM3

BATTLE CREEK BELOW WILSON'S WEIR

STATION NO. 11AB118

MONTH	DAY	YEAR	TIME	DISCHARGES IN M3/S EVERY HOUR								TIME
SEP	21	1986	1-00	0.551	0.547	0.543	0.539	0.535	0.529	0.523	0.517	8-00
			9-00	0.511	0.509	0.512	0.514	0.517	0.519	0.522	0.526	16-00
			17-00	0.533	0.541	0.549	0.556	0.564	0.569	0.573	0.578	24-00
SEP	22	1986	1-00	0.582	0.587	0.590	0.591	0.592	0.593	0.594	0.594	8-00
			9-00	0.595	0.589	0.584	0.355	0.161	0.059	0.036	0.031	16-00
			17-00	0.173	0.234	0.258	0.275	0.283	0.291	0.299	0.305	24-00
SEP	23	1986	1-00	0.308	0.310	0.313	0.316	0.319	0.322	0.325	0.328	8-00
			9-00	0.331	0.334	0.337	0.340	0.343	0.346	0.349	0.349	16-00
			17-00	0.349	0.350	0.350	0.350	0.351	0.351	0.351	0.352	24-00
SEP	24	1986	1-00	0.352	0.352	0.352	0.352	0.353	0.353	0.353	0.353	8-00
			9-00	0.353	0.353	0.354	0.353	0.351	0.349	0.348	0.346	16-00
			17-00	0.344	0.343	0.343	0.345	0.364	0.426	0.456	0.447	24-00
SEP	25	1986	1-00	0.471	0.480	0.511	0.593	0.596	1.460	3.650	5.170	8-00
			9-00	6.310	7.830	7.280	2.800	0.808	0.620	0.550	0.530	16-00
			17-00	0.520	0.510	0.501	0.497	0.493	0.488	0.484	0.474	24-00
SEP	26	1986	1-00	0.462	0.450	0.437	0.425	0.413	0.403	0.392	0.382	8-00
			9-00	0.371	0.362	0.353	0.345	0.337	0.330	0.322	0.315	16-00
			17-00	0.308	0.303	0.300	0.298	0.295	0.293	0.291	0.292	24-00
SEP	27	1986	1-00	0.292	0.293	0.294	0.295	0.296	0.296	0.296	0.296	8-00
			9-00	0.296	0.296	0.293	0.288	0.283	0.277	0.269	0.260	16-00
			17-00	0.251	0.243	0.233	0.223	0.219	0.217	0.215	0.212	24-00
SEP	28	1986	1-00	0.206	0.201	0.196	0.191	0.184	0.177	0.170	0.151	8-00
			9-00	0.121	0.098	0.082	0.067	0.052	0.044	0.039	0.034	16-00
			17-00	0.030	0.025	0.022	0.019	0.016	0.012	0.008	0.006	24-00
SEP	29	1986	1-00	0.006	0.006	0.007	0.008	0.009	0.009	0.010	0.010	8-00
			9-00	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	16-00
			17-00	0.011	0.011	0.010	0.010	0.010	0.009	0.008	0.007	24-00
SEP	30	1986	1-00	0.007	0.008	0.008	0.008	0.008	0.007	0.007	0.007	8-00
			9-00	0.007	0.007	0.008	0.008	0.008	0.008	0.009	0.009	16-00
			17-00	0.009	0.009	0.009	0.009	0.009	0.009	0.008	0.007	24-00
OCT	1	1986	1-00	0.007	0.007	0.007	0.007	0.007	0.006	0.006	0.006	8-00
			9-00	0.006	0.006	0.007	0.007	0.008	0.008	0.008	0.009	16-00
			17-00	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.008	24-00
OCT	2	1986	1-00	0.008	0.008	0.008	0.007	0.007	0.007	0.006	0.006	8-00
			9-00	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.007	16-00
			17-00	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	24-00

FREQUENCY ANALYSIS - LOG PEARSON TYPE III DISTRIBUTION
11AB118 BATTLE CREEK BELOW WILSONS WEIR

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	5.510	5.902	1.071	1.877	11.628
LN X SERIES	1.301	0.989	0.760	0.573	8.581

X(MIN)= 1.110
X(MAX)= 15.700
LOWER OUTLIER LIMIT OF X= 0.724

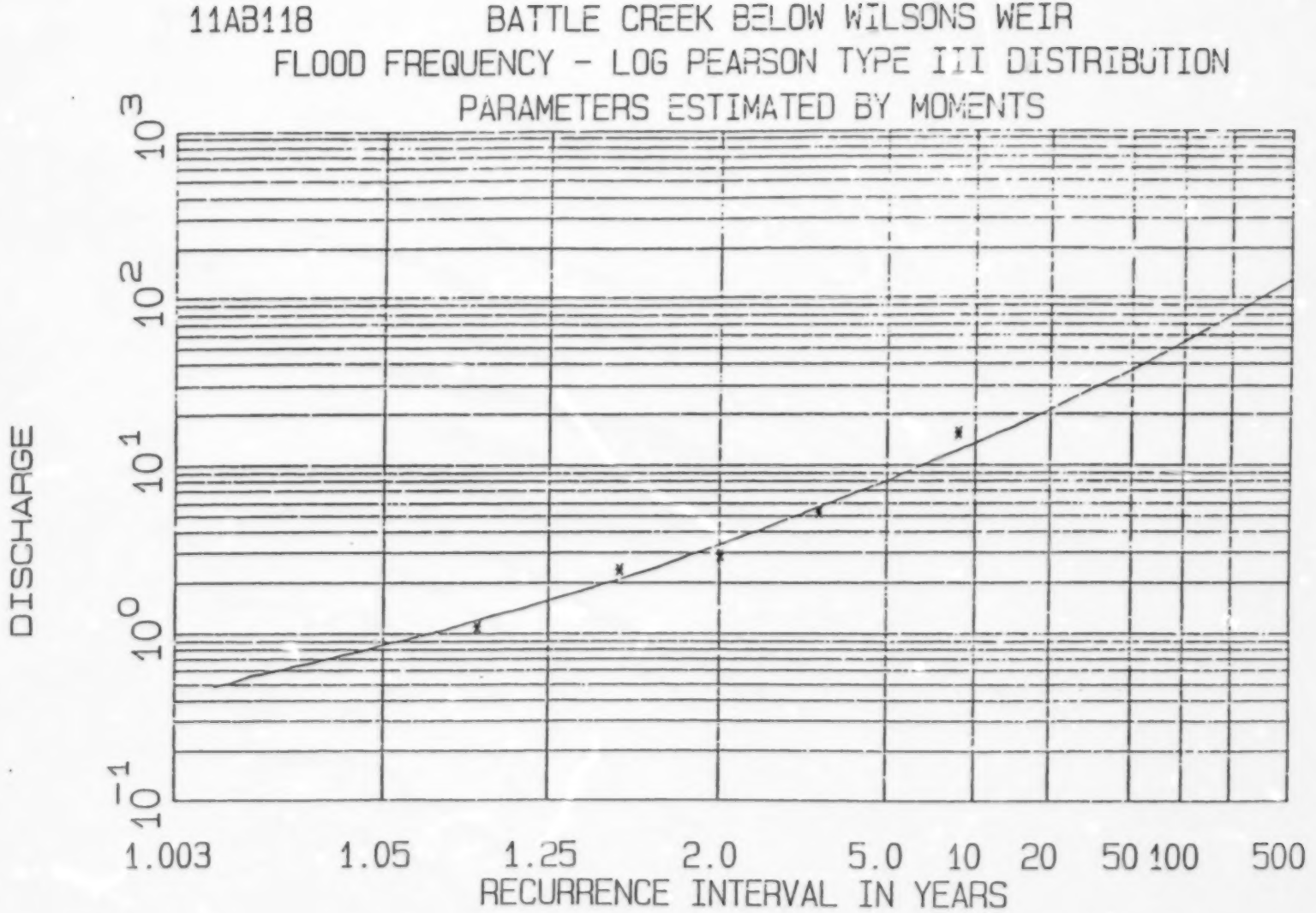
TOTAL SAMPLE SIZE= 5
NO. OF LOW OUTLIERS= 0
NO. OF ZERO FLOWS= 0

SOLUTION OBTAINED VIA MOMENTS

LP3 PARAMETERS: A= 0.2832 B= 12.18 LOG(M)= -2.150
M = 0.1165

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	0.997	0.44
1.050	0.952	0.85
1.250	0.800	1.58
2.000	0.500	3.34
5.000	0.200	8.10
10.000	0.100	13.60
20.000	0.050	21.60
50.000	0.020	37.40
100.000	0.010	55.20
200.000	0.005	79.90
500.000	0.002	127.00


11AB118 BATTLE CREEK BELOW WILSONS WEIR
FLOOD FREQUENCY - LOG PEARSON TYPE III DISTRIBUTION
PARAMETERS ESTIMATED BY MOMENTS
DISCHARGE
10^3
10^2
10^1
10^0
10^{-1}
1.003
1.05
1.25
2.0
5.0
10
20
50
100
500
RECURRENCE INTERVAL IN YEARS

CYPRESS LAKE WEST OUTFLOW CANAL
(11AB077)

LOCATION: LAT. 49-28-14- N., LONG. 109-35-18 W., SW1/4 Sec.16 Twp.6 Rge.27 W3rd.Mer. approximately 19.3 km north of Consul, Sask. and 1.6 km below the Cypress Lake West Dam.

DRAINAGE AREA:

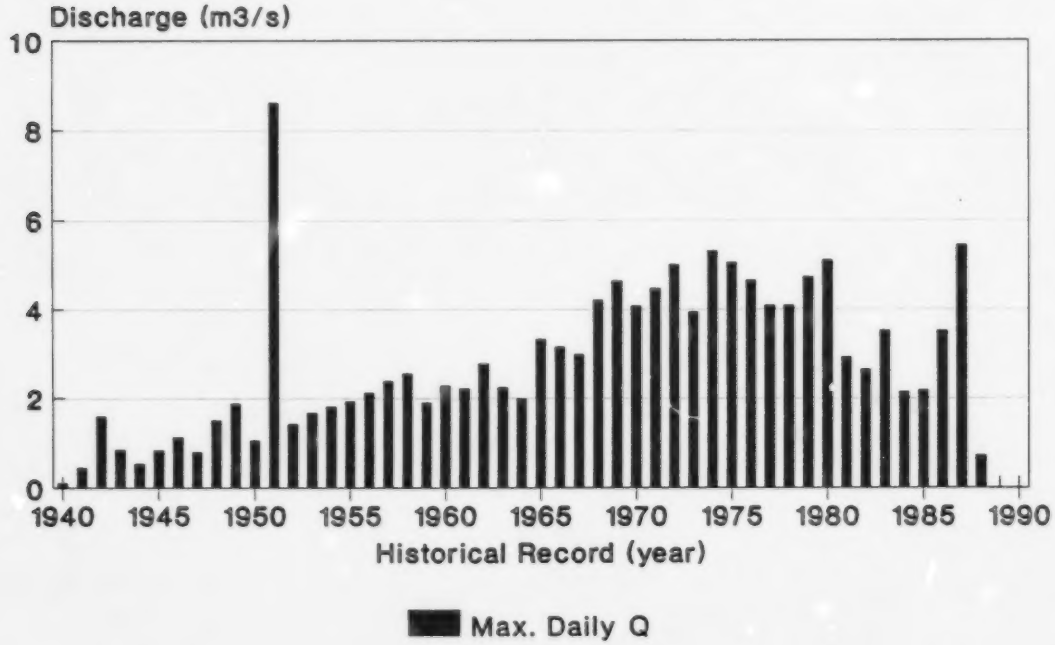
STAGE RECORD: Float activated stage recorder in a standard shelter.

DISCHARGE RECORD: High flows are controlled by a 3 m diameter culvert located 33 m downstream of the gauge. The stage discharge relationship is determined by wading and footbridge measurements.

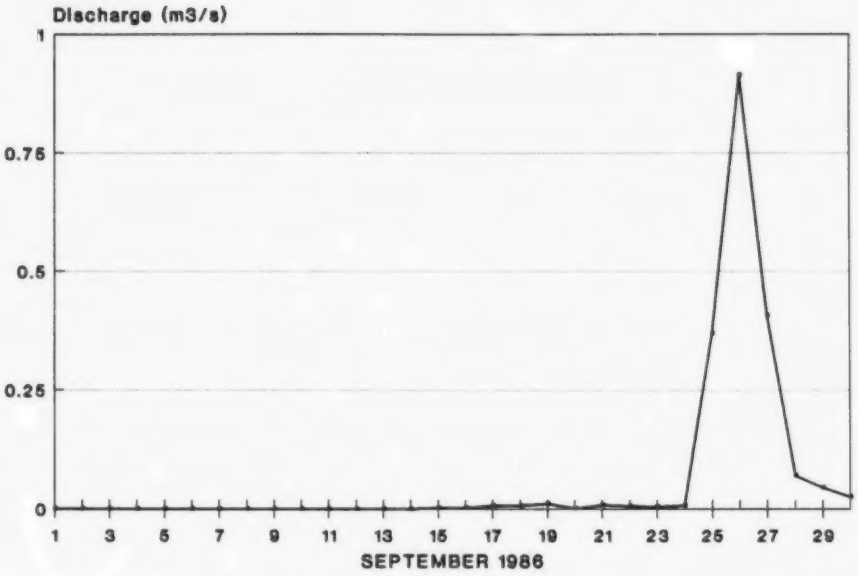
PERIOD OF RECORD: 1940 to date for open water seasons.

RECORDED MAXIMUMS: The maximum instantaneous flows have not been determined. The maximum daily flow was recorded as 8.61 m3/s on May 4,1952, with the next highest flow of 5.42 m3/s occurring on May 4, 1952. By comparison the storm of Sept. 1986 produced a daily maximum of 0.913 m3/s.

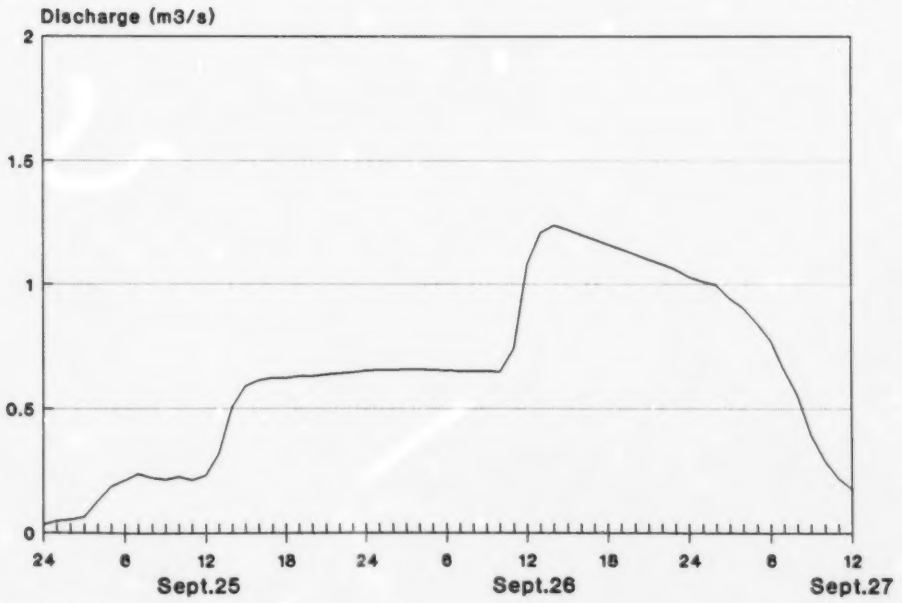
HISTORICAL MAXIMUMS
DAILY DISCHARGE



HYDROGRAPH OF DAILY DISCHARGE
Cypress Lake West Outflow Canal
(11AB077)



HYDROGRAPH OF HOURLY DISCHARGE
Cypress Lake West Outflow Canal
(11AB077)



WATER SURVEY OF CANADA
OCT 01 1988 PAGE 8725
REGINA, SASK.

CYPRESS LAKE WEST OUTFLOW CANAL

STATION NO. 11AB077

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	08	0 B	0.085	0.006	3.26	0.091	0	0	0.019	0.001	---	1
2	---	08	0.359B	0.068	0.005	2.61	0.024	0	0	0.016	0.001	---	2
3	---	08	0.962B	0.090	0.004	2.30	0.020	0	0	0.012	0.002	---	3
4	---	08	0.509B	0.081	0.007	2.56	0.024	0	0	0.008	0.002A	---	4
5	---	08	0.347B	0.080	0.006	2.20	0.026	0	0	0.006	---	---	5
6	---	08	0.219B	0.053	0.005	2.17	0.028	0	0	0.004	---	---	6
7	---	08	0.315B	0.002	0.006	2.43	0.030	0	0	0.002	---	---	7
8	---	08	0.091B	0.001	0.005	2.53	0.027	0	0	0.002	---	---	8
9	---	08	0.072B	0.001	0.007	2.26	0.029	0	0	0.001	---	---	9
10	---	08	0.005B	0.001	0.005	2.19	0.028	0	0	0.001	---	---	10
11	---	08	0.003B	0	0.005	1.88	0.028	0	0	0.001	---	---	11
12	---	08	0.002	0	0.003	1.94	0.028	0	0	0.001	---	---	12
13	---	08	0.002	0	0.013	1.99	0.028	0	0	0.001	---	---	13
14	---	08	0.002	0	0.046	1.81	0.028	0	0	0.001	---	---	14
15	---	08	0.001	0	0.042	1.57	0.029	0	0.002A	0.001	---	---	15
16	---	08	0.002	0	0.031	1.77	0.110	0	0.003	0.001	---	---	16
17	---	08	0.141	0	0.002	1.71	0.143	0	0.007	0.001	---	---	17
18	---	08	0.298	0	0	1.74	0.117	0	0.007	0.001	---	---	18
19	---	08	0.282	0	0.875	1.54	0.085	0	0.011	0.001	---	---	19
20	---	08	0.151	0	2.30	1.49	0.022	0	0.011	0.001	---	---	20
21	---	08	0.005	0	2.24	1.16	0.014	0	0.009	0.001	---	---	21
22	---	08	0.005	0	2.13	0.826	0.008	0	0.006	0.001	---	---	22
23	---	08	0.003	0	2.36	0.837	0.005	0	0.005	0.001	---	---	23
24	---	08	0.003	0	2.92	0.859	0.005	0	0.007	0.001	---	---	24
25	---	08	0.010	0	3.38	0.861	0.004	0	0.369	0.002	---	---	25
26	---	08	0.089	0.001E	3.51	0.845	0.002	0	0.913	0.001	---	---	26
27	---	08	0.092	0.010	3.36	0.814	0.002	0	0.407	0.001	---	---	27
28	---	08	0.104	0.008	3.30	0.484	0.001	0	0.070	0.001	---	---	28
29	---		0.090	0.006	3.28	0.099	0	0	0.045	0.001	---	---	29
30	---		0.088	0.006	3.33	0.091	0	0	0.026	0.002	---	---	30
31	---		0.088		3.49		0	0		0.001		---	31
TOTAL	---	0	4.340	0.493	36.673	48.826	0.986	0	1.898	0.094	---	---	TOTAL
MEAN	---	0	0.140	0.016	1.18	1.63	0.032	0	0.063	0.003	---	---	MEAN
MAX	---	0	0.962	0.090	3.51	3.26	0.143	0	0.913	0.019	---	---	MAX
MIN	---	0	0	0	0	0.091	0	0	0	0.001	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0.381
MAXIMUM DAILY, 3.51 ON MAY 26
MINIMUM DAILY, 08 ON MAR 1

MONTHLY TOTAL DISCHARGE IN CUBIC DECAMETRES

JAN	---	JUL	85.2
FEB	0	AUG	0
MAR	375	SEP	164
APR	42.6	OCT	8.12
MAY	3 170	NOV	---
JUN	4 220	DEC	---

TOTAL DISCHARGE, 8 060 DAM3

A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED

WATER SURVEY OF CANADA
JAN 26 1989 PAGE 6
REGINA, SASK. 20:55

CYPRESS LAKE WEST OUTFLOW CANAL

STATION NO. 11AB077

MONTH	DAY	YEAR	TIME	DISCHARGES IN M3/S EVERY HOUR								TIME
SEP	21	1986	1-00	0.011	0.011	0.011	0.010	0.010	0.010	0.010	0.010	8-00
			9-00	0.010	0.010	0.010	0.009	0.009	0.009	0.008	0.008	16-00
			17-00	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	24-00
SEP	22	1986	1-00	0.008	0.008	0.007	0.007	0.008	0.008	0.008	0.008	8-00
			9-00	0.008	0.007	0.007	0.007	0.006	0.006	0.005	0.005	16-00
			17-00	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	24-00
SEP	23	1986	1-00	0.006	0.005	0.005	0.005	0.005	0.005	0.005	0.005	8-00
			9-00	0.006	0.006	0.006	0.006	0.006	0.006	0.005	0.004	16-00
			17-00	0.004	0.003	0.004	0.004	0.004	0.004	0.004	0.004	24-00
SEP	24	1986	1-00	0.004	0.004	0.004	0.005	0.005	0.005	0.005	0.005	8-00
			9-00	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	16-00
			17-00	0.005	0.005	0.005	0.005	0.007	0.015	0.024	0.033	24-00
SEP	25	1986	1-00	0.050	0.053	0.066	0.131	0.189	0.214	0.239	0.222	8-00
			9-00	0.216	0.227	0.213	0.231	0.320	0.504	0.590	0.613	16-00
			17-00	0.622	0.627	0.629	0.630	0.635	0.640	0.646	0.652	24-00
SEP	26	1986	1-00	0.655	0.655	0.656	0.656	0.655	0.653	0.651	0.649	8-00
			9-00	0.649	0.648	0.742	1.080	1.210	1.240	1.220	1.200	16-00
			17-00	1.180	1.160	1.140	1.120	1.100	1.080	1.060	1.030	24-00
SEP	27	1986	1-00	1.010	0.977	0.943	0.905	0.841	0.774	0.654	0.551	8-00
			9-00	0.396	0.291	0.220	0.177	0.164	0.155	0.149	0.144	16-00
			17-00	0.138	0.132	0.125	0.118	0.112	0.106	0.101	0.096	24-00
SEP	28	1986	1-00	0.093	0.089	0.086	0.082	0.080	0.078	0.076	0.074	8-00
			9-00	0.071	0.069	0.067	0.064	0.063	0.065	0.066	0.067	16-00
			17-00	0.066	0.066	0.064	0.062	0.059	0.058	0.057	0.056	24-00
SEP	29	1986	1-00	0.055	0.054	0.052	0.051	0.050	0.049	0.049	0.048	8-00
			9-00	0.048	0.047	0.047	0.045	0.042	0.041	0.042	0.042	16-00
			17-00	0.042	0.041	0.040	0.039	0.038	0.037	0.036	0.035	24-00
SEP	30	1986	1-00	0.034	0.033	0.032	0.031	0.031	0.030	0.029	0.028	8-00
			9-00	0.027	0.027	0.026	0.025	0.024	0.024	0.024	0.023	16-00
			17-00	0.023	0.023	0.023	0.023	0.024	0.023	0.023	0.022	24-00
OCT	1	1986	1-00	0.022	0.021	0.021	0.020	0.020	0.020	0.020	0.019	8-00
			9-00	0.019	0.019	0.019	0.019	0.019	0.019	0.018	0.018	16-00
			17-00	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	24-00
OCT	2	1986	1-00	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	8-00
			9-00	0.017	0.017	0.017	0.016	0.016	0.015	0.015	0.015	16-00
			17-00	0.015	0.014	0.014	0.014	0.014	0.014	0.013	0.013	24-00

BATTLE CREEK NEAR CONSUL
(11AB096)

LOCATION: LAT. 49-17-12 N., LONG. 109-31-22 W., NW1/4 Sec.12 Twp.4 Rge.27 W3rd.Mer. approximately 0.8 km south of Consul,Sask. on the road to Nashlyn.

DRAINAGE AREA: 1850 km2

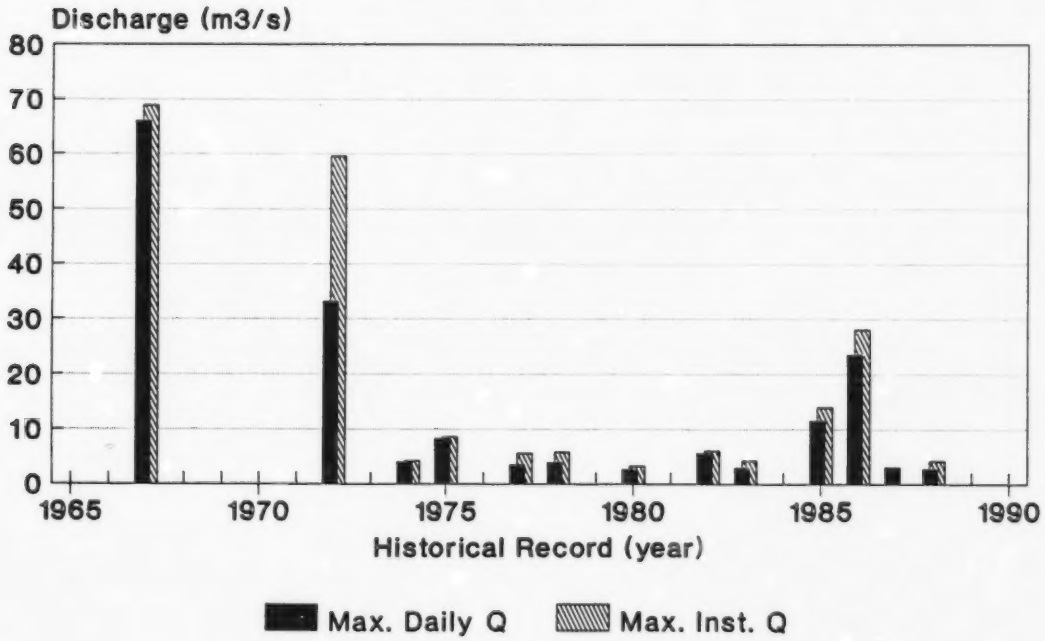
STAGE RECORD: Float activated recorder in a standard shelter

DISCHARGE RECORD: Stage-discharge relationship determined by wading measurements.

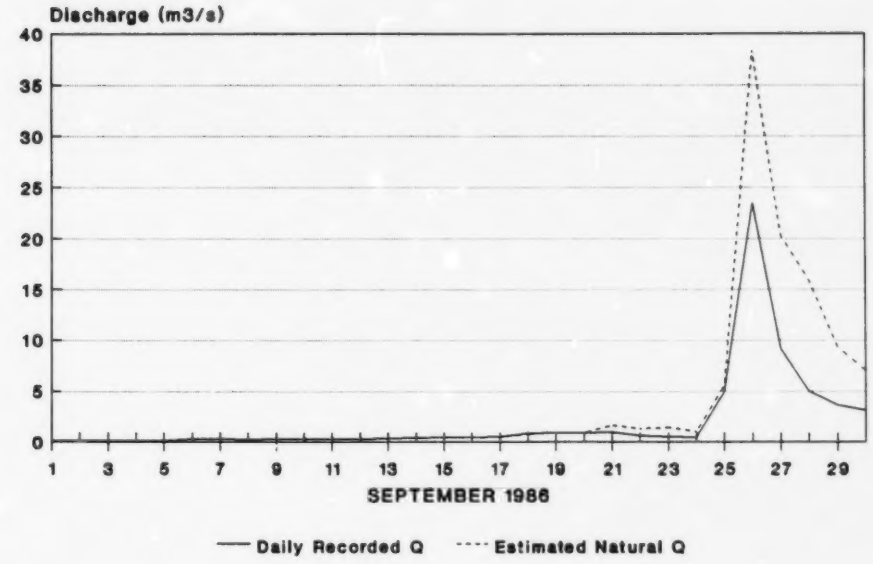
PERIOD OF RECORD: Intermittent records for 1967 to present for open water seasons.

RECORDED MAXIMUMS: Maximum instantaneous recorded flows are 68.8 m3/s (07:00 MST May 20, 1967) and 59.5 m3/s (12:15 CST June 9, 1972). The maximum daily flows are 66.0 m3/s (May 20, 1967) and 33.1 m3/s (June 9, 1972) . The maximum daily discharge resulting from the September 1986 storm is 23.5 m3/s (Sept. 26,1986) and the maximum instantaneous discharge recorded was 28.1 m3/s (12:15 CST Sept. 26,1986).

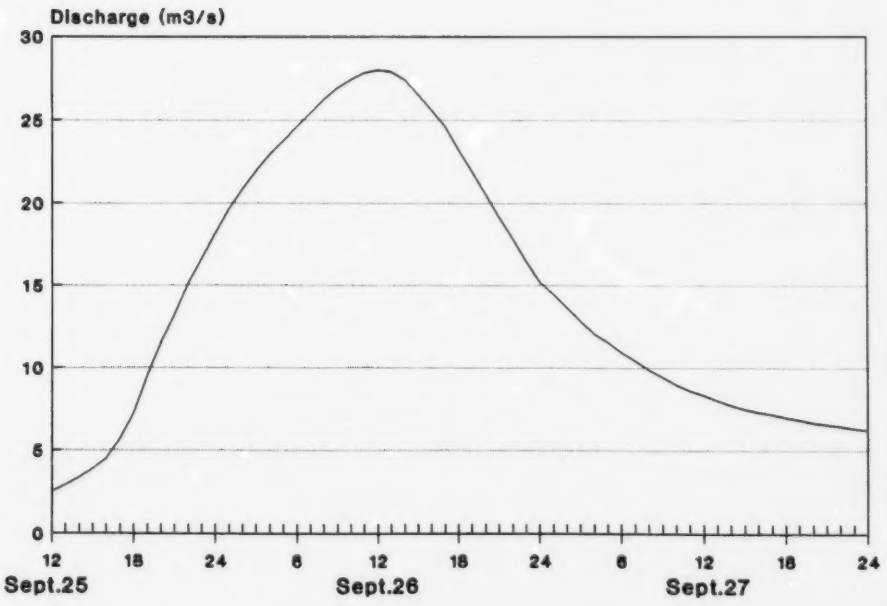
HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
Battle Creek Near Consul
(11AB096)



HYDROGRAPH OF HOURLY DISCHARGE
Battle Creek Near Consul
(11AB096)



NATURAL DAILY FLOW ESTIMATION

SEPTEMBER 1986

BATTLE CREEK NEAR CONSUL

STATION 11AB096

Using international apportionment figures, the time of travel from Battle Creek below Wilson's Weir (11AB118) to Battle Creek near Consul (11AB096) is approximately 1 day. Channel losses, as determined for division purposes, are 2.419 dam^3/day. This would reduce flow from Adams Lake by 0.028 m^3/s. Channel losses from diverted waters going past Cypress Lake West Inflow Canal (11AB078) are also included. Therefore the natural flow at (11AB096) was estimated according to;

$$\text{NATURAL } Q_{096} = \text{RECORDED } Q_{096} + (\text{RECORDED } Q_{078} - \text{CH.LOSS}) + (Q_{ADAM'S} - \text{CH.LOSS}) - (Q_{077} + Q_{085} - \text{CH.LOSS})$$

Where:

NATURAL Q_{096} = natural discharge at station Battle Creek near Consul (11AB096)
RECORDED Q_{096} = recorded discharge at station Battle Creek near Consul(11AB096)
Q_{078} = recorded discharge station Cypress Lake West Inflow (11AB078)
Q_{077} = recorded discharge station Cypress Lake West Outflow (11AB077)
Q_{085} = recorded discharge at station Cypress Lake Inflow Canal Drain (11AB085)
Q_{ADAMS} = estimated discharge from Adams Lake Reservoir

There is a 3 day lag from Adams Lake to Battle Creek near Consul (11AB096) so waters accumulated on September 24, 25 were added to Sept 27, 28 recorded flows at 11AB096. The maximum daily flow estimated was 38.275 m^3/s (Sept. 26). This is an increase over the recorded flow of 14.78 m^3/s.

BATTLE CREEK NEAR CONSUL

STATION NO. 11AB096

MONTH	DAY	YEAR	TIME	DISCHARGES IN M3/S EVERY HOUR								TIME
SEP	21	1986	1-00	1.030	1.060	1.090	1.120	1.140	1.150	1.150	1.120	8-00
			9-00	1.100	1.070	1.040	1.010	0.984	0.955	0.938	0.920	16-00
			17-00	0.902	0.885	0.869	0.851	0.834	0.816	0.799	0.781	24-00
SEP	22	1986	1-00	0.764	0.751	0.738	0.725	0.712	0.699	0.686	0.674	8-00
			9-00	0.663	0.651	0.641	0.630	0.620	0.611	0.605	0.600	16-00
			17-00	0.594	0.588	0.583	0.578	0.573	0.569	0.564	0.559	24-00
SEP	23	1986	1-00	0.554	0.549	0.545	0.545	0.551	0.556	0.559	0.552	8-00
			9-00	0.545	0.537	0.530	0.525	0.519	0.521	0.526	0.530	16-00
			17-00	0.533	0.535	0.537	0.539	0.540	0.542	0.544	0.546	24-00
SEP	24	1986	1-00	0.549	0.550	0.549	0.547	0.545	0.543	0.543	0.542	8-00
			9-00	0.542	0.542	0.533	0.520	0.507	0.494	0.479	0.464	16-00
			17-00	0.446	0.428	0.402	0.385	0.372	0.393	0.416	0.447	24-00
SEP	25	1986	1-00	0.511	0.581	0.661	0.769	0.878	1.000	1.200	1.400	8-00
			9-00	1.620	1.840	2.120	2.510	2.900	3.380	3.910	4.490	16-00
			17-00	5.730	7.230	9.550	11.500	13.200	15.100	16.600	18.100	24-00
SEP	26	1986	1-00	19.600	20.800	21.900	22.800	23.700	24.600	25.400	26.200	8-00
			9-00	26.900	27.400	27.800	28.000	27.900	27.400	26.500	25.600	16-00
			17-00	24.600	23.200	21.900	20.500	19.100	17.800	16.400	15.200	24-00
SEP	27	1986	1-00	14.400	13.600	12.800	12.000	11.500	10.900	10.400	9.850	8-00
			9-00	9.390	8.940	8.610	8.300	8.010	7.730	7.460	7.310	16-00
			17-00	7.140	6.980	6.830	6.680	6.560	6.440	6.320	6.200	24-00
SEP	28	1986	1-00	6.080	5.960	5.850	5.740	5.640	5.540	5.440	5.340	8-00
			9-00	5.240	5.140	5.030	4.930	4.830	4.740	4.660	4.590	16-00
			17-00	4.500	4.410	4.320	4.230	4.150	4.080	4.020	3.960	24-00
SEP	29	1986	1-00	3.910	3.860	3.820	3.790	3.750	3.710	3.680	3.640	8-00
			9-00	3.620	3.590	3.570	3.550	3.530	3.530	3.520	3.520	16-00
			17-00	3.510	3.490	3.460	3.440	3.420	3.390	3.370	3.350	24-00
SEP	30	1986	1-00	3.330	3.310	3.290	3.270	3.240	3.230	3.210	3.190	8-00
			9-00	3.180	3.150	3.130	3.110	3.080	3.100	3.080	3.050	16-00
			17-00	3.020	2.990	2.960	2.930	2.910	2.880	2.860	2.830	24-00
OCT	1	1986	1-00	2.800	2.780	2.760	2.740	2.720	2.710	2.690	2.670	8-00
			9-00	2.650	2.640	2.620	2.600	2.590	2.580	2.560	2.550	16-00
			17-00	2.530	2.520	2.510	2.490	2.480	2.460	2.450	2.430	24-00
OCT	2	1986	1-00	2.420	2.400	2.390	2.370	2.360	2.340	2.330	2.310	8-00
			9-00	2.300	2.280	2.270	2.250	2.240	2.220	2.210	2.200	16-00
			17-00	2.180	2.170	2.150	2.130	2.110	2.100	2.080	2.060	24-00

WATER SURVEY OF CANADA
OCT 01 1988 PAGE 8983
REGINA, SASK.

BATTLE CREEK NEAR CONSUL

STATION NO. 11AB096

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	1.91	0.059	1.57	0.588	0.312	0.140	2.61	0.778	---	1
2	---	---	---	1.78	0.056	1.49	0.438	0.284	0.145	2.25	0.978	---	2
3	---	---	---	1.39	0.063	1.01	0.553	0.269	0.151	1.83	1.12	---	3
4	---	---	---	1.11	0.074	1.05	0.580	0.261	0.142	1.43	1.17 A	---	4
5	---	---	---	1.05	0.098	0.936	0.500	0.265	0.151	1.09	---	---	5
6	---	---	---	0.866	0.100	1.18	0.385	0.264	0.277	0.888	---	---	6
7	---	---	---	0.814	0.103	1.43	0.290	0.249	0.306	0.753	---	---	7
8	---	---	---	0.650	0.098	1.50	0.263	0.233	0.263	0.648	---	---	8
9	---	---	---	0.628	0.121	2.27	0.252	0.216	0.288	0.499	---	---	9
10	---	---	---	0.586	0.120	2.64	0.318	0.218	0.318	0.357	---	---	10
11	---	---	---	0.616	0.145	2.13	0.372	0.222	0.326	0.311	---	---	11
12	---	---	0.737B	0.607	0.134	1.40	0.300	0.221	0.312	0.316	---	---	12
13	---	---	0.337B	0.285	0.125	1.29	0.264	0.231	0.338	0.300	---	---	13
14	---	---	0.638B	0.174	0.119	1.41	0.230	0.226	0.402	0.258	---	---	14
15	---	---	0.358B	0.134	0.112	1.62	0.227	0.211	0.471	0.250	---	---	15
16	---	---	0.432B	0.125	0.088	1.36	0.307	0.196	0.480	0.235	---	---	16
17	---	---	0.501B	0.140	0.090	1.08	0.931	0.190	0.514	0.217	---	---	17
18	---	---	0.524B	0.127	0.108	1.28	3.76	0.190	0.843	0.209	---	---	18
19	---	---	0.103B	0.115	0.111	1.69	1.02	0.181	0.917	0.204	---	---	19
20	---	---	0.221B	0.091	0.101	1.55	0.485	0.169	0.934	1.02	---	---	20
21	---	---	0.574B	0.095	0.263	1.60	0.351	0.163	0.985	1.16	---	---	21
22	---	---	1.05 B	0.095	1.06	1.02	0.273	0.154	0.642	1.15	---	---	22
23	---	---	1.51 B	0.082	1.90	0.598	0.231	0.146	0.540	1.15	---	---	23
24	---	---	1.64 B	0.069	1.46	0.576	0.206	0.141	0.489A	1.17	---	---	24
25	---	---	1.53 B	0.069	1.59	0.495	0.255	0.135	4.93 A	1.14	---	---	25
26	---	---	1.55	0.070	1.63	0.439	0.448	0.124	23.5 A	1.13	---	---	26
27	---	---	1.76	0.065	1.74	0.458	0.469	0.128	9.12	1.14	---	---	27
28	---	---	1.68	0.066	1.67	0.400	0.407	0.129	4.98	1.10	---	---	28
29	---		1.61	0.061	1.84	0.361	0.379	0.126	3.60	1.05	---	---	29
30	---		1.47	0.058	1.71	0.345	0.345	0.131	3.11	1.04	---	---	30
31	---		1.88		1.76		0.324	0.148		1.05		---	31
TOTAL	---	---	---	13.928	18.648	36.178	15.551	6.133	59.614	27.955	---	---	TOTAL
MEAN	---	---	---	0.464	0.602	1.21	0.502	0.198	1.99	0.902	---	---	MEAN
MAX	---	---	---	1.91	1.90	2.64	3.76	0.312	23.5	2.61	---	---	MAX
MIN	---	---	---	0.058	0.056	0.345	0.206	0.124	0.140	0.204	---	---	MIN

SUMMARY FOR THE MONTHS APR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0.832
MAXIMUM DAILY, 23.5A ON SEP 26

MAXIMUM INSTANTANEOUS,
28.1A AT 12:35 CST ON SEP 26

A - MANUAL GAUGE
B - ICE CONDITIONS

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	---	JUL	1 340
FEB	---	AUG	530
MAR	---	SEP	5 150
APR	1 200	OCT	2 420
MAY	1 610	NOV	---
JUN	3 130	DEC	---

TOTAL DISCHARGE, 15 400 DAM3

NASHLYN CANAL NEAR CONSUL
(11AB018)

LOCATION: LAT. 49-13-56 N., LONG. 109-33-27 W., NE1/4 Sec.22 Twp.3 Rge.27 W3rd.Mer. approximately 6.4 km south and 3 km west of Consul.

DRAINAGE AREA:

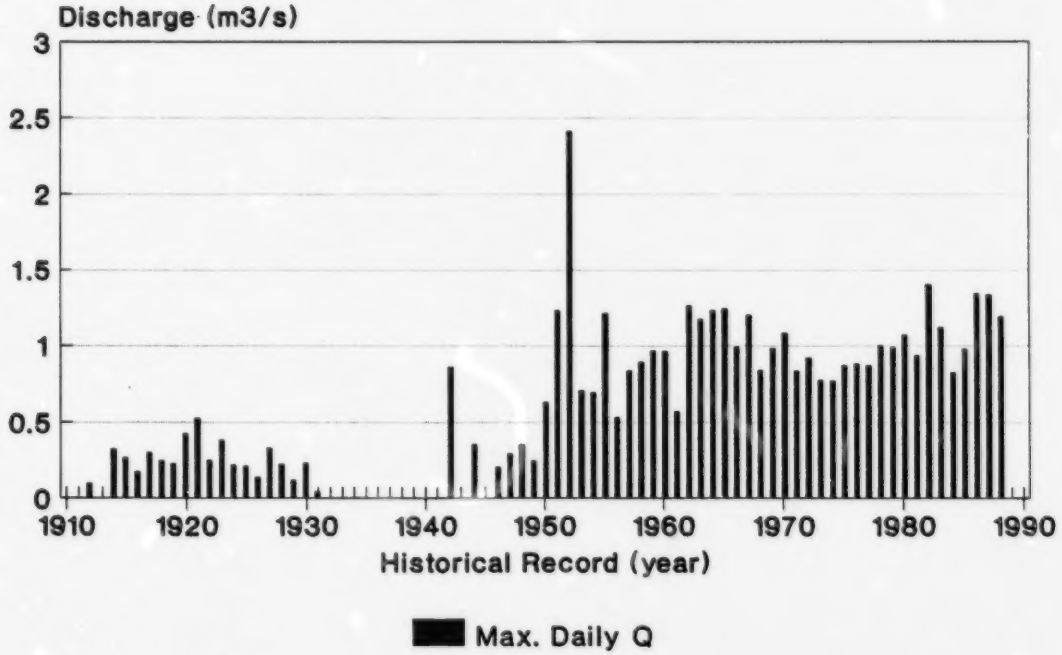
DISCHARGE RECORD: Stage-discharge relationship determined by wading and bridge measurements. Relation may be affected by weed growth and check structures below the metering section.

STAGE RECORD: Float activated recorder in standard shelter.

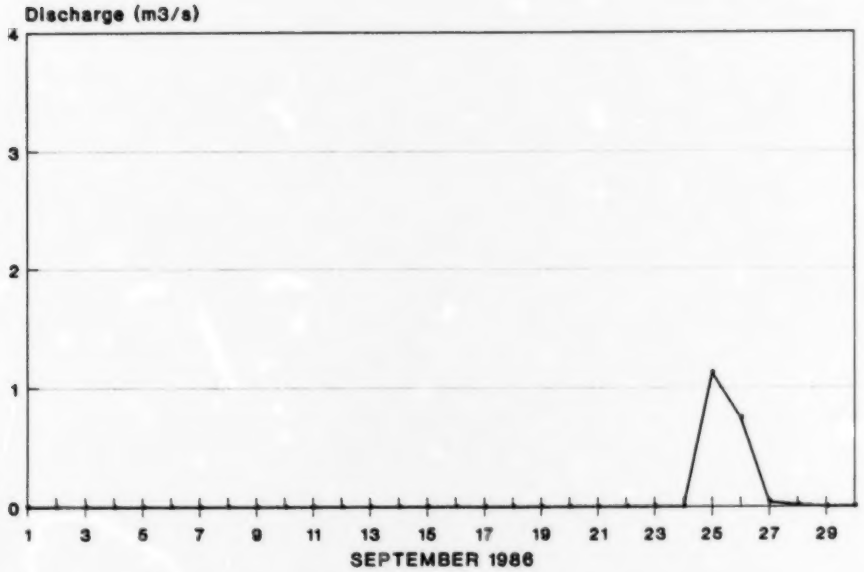
PERIOD OF RECORD: 1912 to present for open water seasons.

RECORDED MAXIMUMS: The maximum daily discharge recorded is 2.41 m3/s (Apr. 14,1952) with a second highest value of 1.40 m3/s (Apr.22,1982). During the Sept. 1986 storm the maximum daily discharge was 1.12 m3/s (Sept.25, 1986).

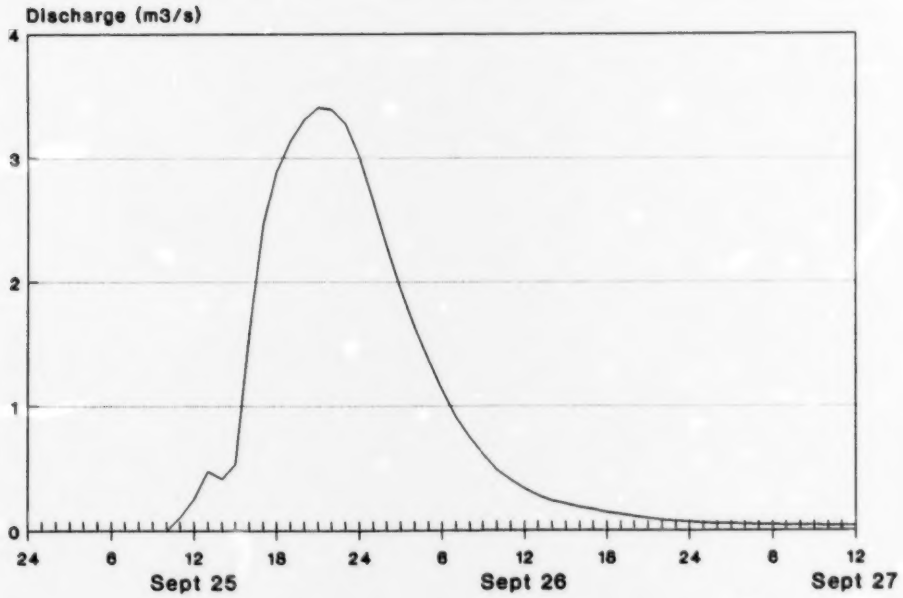
HISTORICAL MAXIMUMS
DAILY DISCHARGE



HYDROGRAPH OF DAILY DISCHARGE
Nashlyn Canal at Consul
(11AB018)



HYDROGRAPH OF HOURLY DISCHARGE
Nashlyn Canal at Consul
(11AB018)



WATER SURVEY OF CANADA
OCT 01 1988 PAGE 8105
REGINA, SASK.

NASHLYN CANAL NEAR CONSUL

STATION NO. 11AB018

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	0.069	0.359	0	0.778	0	0	0	0	---	---	1
2	---	---	0.752	0.355	0	0.540	0	0	0	0	---	---	2
3	---	---	1.17	0.359	0	0.348	0	0	0	0	---	---	3
4	---	---	1.16	0.303	0	0.038	0	0	0	0	---	---	4
5	---	---	1.29	0.061	0	0	0	0	0	0	---	---	5
6	---	---	1.30	0.041	0	0	0	0	0	0	---	---	6
7	---	---	1.34	0.474	0	0	0	0	0	0	---	---	7
8	---	---	1.08	0.555	0	0	0	0	0	0	---	---	8
9	---	---	1.19	0.365	0	0	0	0	0	0	---	---	9
10	---	---	1.19	0.091	0	0	0	0	0	0	---	---	10
11	---	---	1.11	0.044	0	0	0	0	0	0	---	---	11
12	---	---	0.868	0.027	0	0	0	0	0	0	---	---	12
13	---	---	0.709	0.018	0	0	0	0	0	0	---	---	13
14	---	---	0.544	0.007	0	0	0	0	0	0	---	---	14
15	---	---	0.543	0	0	0	0	0	0	0	---	---	15
16	---	---	0.448	0	0	0	0	0	0	0	---	---	16
17	---	---	0.429	0	0	0	0	0	0	0	---	---	17
18	---	---	0.465	0	0	0	0	0	0	0	---	---	18
19	---	---	0.388	0	0	0	0	0	0	0	---	---	19
20	---	---	0.378	0	0	0	0	0	0	0	---	---	20
21	---	---	0.631	0	0	0	0	0	0	0	---	---	21
22	---	---	0.931	0	0	0	0	0	0	0	---	---	22
23	---	---	1.06	0	0	0	0	0	0	0	---	---	23
24	---	0	1.02	0	0	0	0	0	0	0	---	---	24
25	---	0 A	0.915	0	0	0	0	0	1.12 A	0	---	---	25
26	---	0.032	0.899	0	0.043A	0	0	0	0.743	0	---	---	26
27	---	0.141	0.402	0	0.708	0	0	0	0.038	0	---	---	27
28	---	0.057	0.377	0	0.897	0	0	0	0.015	0	---	---	28
29	---		0.365	0	0.899	0	0	0	0	0	---	---	29
30	---		0.366	0	0.910	0	0	0	0	0	---	---	30
31	---		0.358		0.906		0	0		0		---	31
TOTAL	---	---	23.747	3.059	4.363	1.704	0	0	1.916	0	---	---	TOTAL
MEAN	---	---	0.766	0.102	0.141	0.057	0	0	0.064	0	---	---	MEAN
MAX	---	---	1.34	0.555	0.910	0.778	0	0	1.12	0	---	---	MAX
MIN	---	---	0.069	0	0	0	0	0	0	0	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0.142
MAXIMUM DAILY, 1.34 ON MAR 7
MINIMUM DAILY, 0 ON APR 15

A - MANUAL GAUGE

MONTHLY TOTAL DISCHARGE IN CUBIC DECAMETRES

JAN	---	JUL	0
FEB	---	AUG	0
MAR	2 050	SEP	166
APR	264	OCT	0
MAY	377	NOV	---
JUN	147	DEC	---

TOTAL DISCHARGE, 3 000 DAM3

NASHLYN CANAL NEAR CONSUL

STATION NO. 11AB018

MONTH	DAY	YEAR	TIME	DISCHARGES IN M3/S EVERY HOUR								TIME
SEP	21	1986	1-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	8-00
			9-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	16-00
			17-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	24-00
SEP	22	1986	1-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	8-00
			9-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	16-00
			17-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	24-00
SEP	23	1986	1-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	8-00
			9-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	16-00
			17-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	24-00
SEP	24	1986	1-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	8-00
			9-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	16-00
			17-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	24-00
SEP	25	1986	1-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8-00
			9-00	0.000	0.001	0.109	0.256	0.476	0.415	0.532	1.600	16-00
			17-00	2.470	2.890	3.140	3.310	3.410	3.390	3.280	3.010	24-00
SEP	26	1986	1-00	2.650	2.290	1.940	1.630	1.370	1.130	0.912	0.747	8-00
			9-00	0.613	0.488	0.406	0.339	0.282	0.240	0.213	0.189	16-00
			17-00	0.167	0.147	0.129	0.112	0.097	0.085	0.075	0.068	24-00
SEP	27	1986	1-00	0.061	0.058	0.054	0.051	0.048	0.046	0.044	0.042	8-00
			9-00	0.040	0.038	0.038	0.037	0.036	0.035	0.034	0.032	16-00
			17-00	0.030	0.028	0.026	0.025	0.024	0.023	0.022	0.022	24-00
SEP	28	1986	1-00	0.021	0.021	0.020	0.020	0.020	0.020	0.019	0.019	8-00
			9-00	0.018	0.018	0.017	0.016	0.016	0.015	0.015	0.014	16-00
			17-00	0.013	0.011	0.010	0.008	0.007	0.005	0.003	0.002	24-00
SEP	29	1986	1-00	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	8-00
			9-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16-00
			17-00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	24-00
SEP	30	1986	1-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	8-00
			9-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	16-00
			17-00	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	-9999.999	24-00

BATTLE CREEK BELOW NASHLYN PROJECT
(11AB101)

LOCATION: LAT. 49-09-52 N., LONG 109-27-52 W., SE1/4 Sec.31 Twp.2 Rge.26 W3rd.Mer. approximately 14.5 km south and 4.8 km east of Consul,Sask.

DRAINAGE AREA: 2210 km2

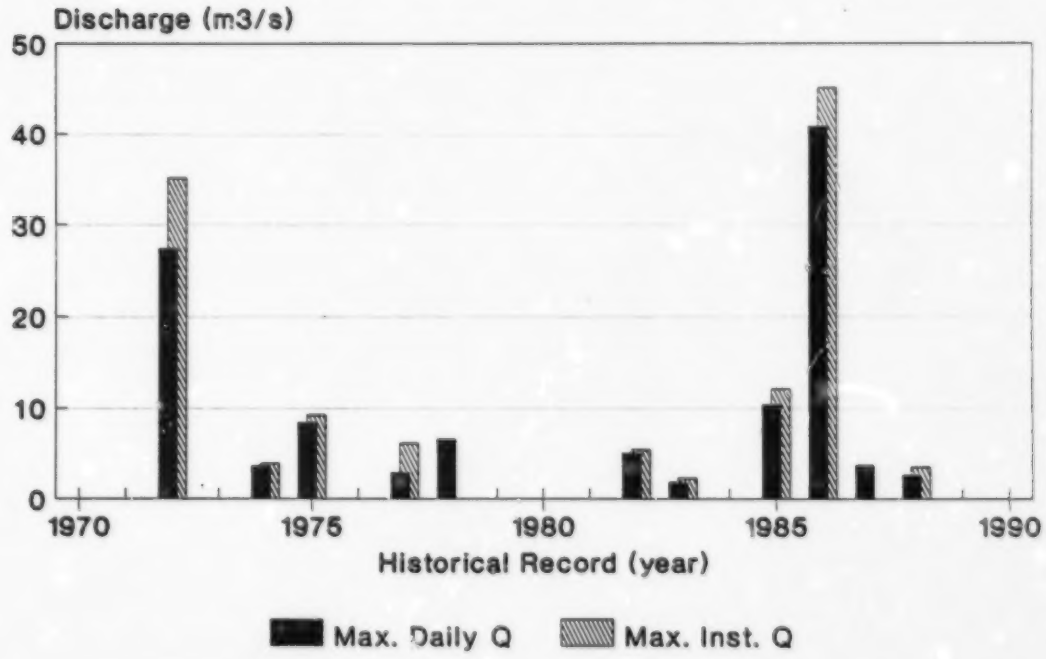
STAGE RECORD: Float activated recorder in standard shelter.

DISCHARGE RECORD: Stage-discharge relationship determined by wading. No provision has been made for high water measurements.

PERIOD OF RECORD: 1964 to present for open water seasons.

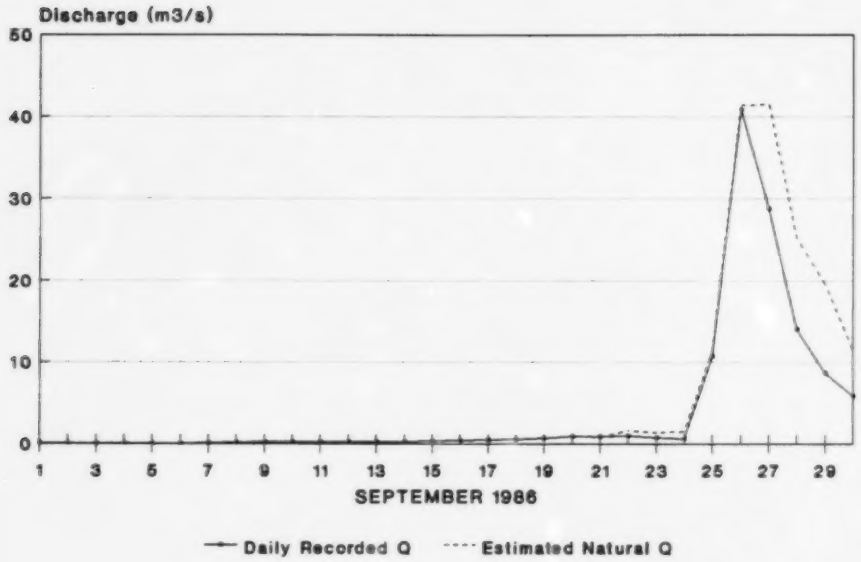
RECORDED MAXIMUMS: Intermittant determinations of maximum instantaneous discharge have been made for the period 1972 to present, resulting in a maximum recorded value of 45.1 m3/s (10:44 CST Sept.26, 1986) . A previous high of 35.1 m3/s occurred at 14:10 CST June 10, 1972. The maximum daily flow is 40.8 m3/s (Sept.26, 1986) with a previous high of 27.4 m3/s (June 10, 1972).

HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



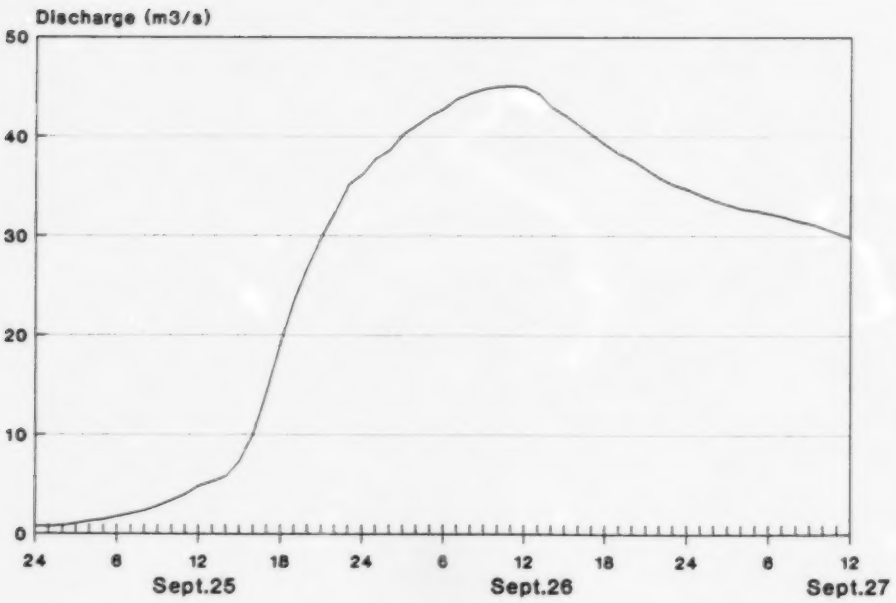
HYDROGRAPH OF DAILY DISCHARGE

Battle Creek below Nashlyn Project
(11AB101)



HYDROGRAPH OF HOURLY DISCHARGE

Battle Creek Below Nashlyn Project
(11AB101)



NATURAL DAILY FLOW ESTIMATION

SEPTEMBER 1986

BATTLE CREEK BELOW NASHLYN PROJECT

STATION 11AB101

The natural flow at 11AB101 was calculated using a 2 day lag time for flows from the Cypress Lake west diversion canal area and a 4 day lag for flows from Adam's Lake. Estimations were calculated as:

$$\text{NATURAL } Q_{101} = \text{RECORDED } (Q_{101}) - \text{RECORDED } (Q_{077} + Q_{085} - \text{CH.LOSS}) + (\text{RECORDED } Q_{078} - \text{CH.LOSS}) + (Q_{ADAMs} - \text{CH.LOSS})$$

The maximum daily flow estimated was 41.45 m^3/s (Sept. 27). This was 0.65 m^3/s above the recorded value.

Where:

Natural Q_{101} = estimated natural discharge at Battle Creek below Wilson's Weir

Recorded Q_{101} = recorded discharge at Battle Creek below Wilson's Weir

Recorded Q_{078} = recorded discharge at Cypress Lake West Inflow Canal

Q_{ADAMS} = estimated discharge from Adam's Reservoir

CH.LOSS = channel losses

WATER SURVEY OF CANADA
OCT 01 1988 PAGE 9024
REGINA, SASK.

BATTLE CREEK BELOW NASHLYN PROJECT

STATION NO. 11AB101

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	---	1.85	0.147	1.08	0.392	0.316	0.097	4.47	1.05	---	1
2	---	---	---	1.78	0.138	1.09	0.359	0.303	0.094	3.63	0.963	---	2
3	---	---	---	1.60	0.129	1.12	0.377	0.293	0.103	3.06	1.02	---	3
4	---	---	---	1.33	0.117	0.999	0.425	0.282	0.098	2.48	1.24 A	---	4
5	---	---	---	1.31	0.164	1.15	0.510	0.264	0.127	1.89	---	---	5
6	---	---	---	1.28	0.169	1.10	0.492	0.251	0.132	1.46	---	---	6
7	---	---	---	0.994	0.157	1.05	0.442	0.229	0.143	1.24	---	---	7
8	---	---	---	0.733	0.147	1.21	0.377	0.232	0.221	1.05	---	---	8
9	---	---	---	0.640	0.201	1.24	0.330	0.232	0.343	0.921	---	---	9
10	---	---	---	0.738	0.229	1.69	0.294	0.218	0.333	0.760	---	---	10
11	---	---	---	0.853	0.248	2.30	0.287	0.196	0.317	0.598	---	---	11
12	---	---	0.679B	0.817	0.251	1.95	0.295	0.191	0.307	0.494	---	---	12
13	---	---	0.452B	0.705	0.233	1.22	0.361	0.207	0.321	0.529	---	---	13
14	---	---	0.790B	0.699	0.204	1.08	0.319	0.214	0.327	0.454	---	---	14
15	---	---	0.578B	0.669	0.193	1.12	0.288	0.212	0.369	0.409	---	---	15
16	---	---	0.303B	0.457	0.190	1.23	0.286	0.207	0.428	0.384	---	---	16
17	---	---	0.437B	0.418	0.186	1.14	0.311	0.193	0.503	0.358	---	---	17
18	---	---	0.592B	0.368	0.166	1.02	0.374	0.172	0.565	0.337	---	---	18
19	---	---	0.522B	0.323	0.149	1.20	2.08	0.169	0.749	0.336	---	---	19
20	---	---	0.621B	0.295	0.153	1.23	1.23	0.166	0.956	0.326	---	---	20
21	---	---	0.858B	0.279	0.168	1.24	0.663	0.167	0.918	0.805	---	---	21
22	---	---	0.778B	0.256	0.235	1.19	0.457	0.172	1.04	1.18	---	---	22
23	---	---	1.01 B	0.238	0.769	1.00	0.374	0.144	0.808	1.17	---	---	23
24	---	---	1.51 B	0.239	1.48	0.689	0.336	0.145	0.631	1.16	---	---	24
25	---	---	1.66 B	0.228	1.29	0.592	0.270	0.139	10.7	1.17	---	---	25
26	---	---	1.31 B	0.210	1.34	0.526	0.242	0.139	40.8 A	1.16	---	---	26
27	---	---	1.49 B	0.204	1.08	0.467	0.220	0.100	28.7	1.15	---	---	27
28	---	---	1.88	0.186	0.893	0.430	0.407	0.099	14.0	1.14	---	---	28
29	---		1.88	0.170	0.816	0.510	0.398	0.093	8.65	1.10	---	---	29
30	---		1.78	0.148	0.946	0.467	0.354	0.092	5.84	1.07	---	---	30
31	---		1.64		1.02		0.328	0.115		1.05		---	31
TOTAL	---	---	---	20.017	13.608	32.330	13.878	5.952	118.620	37.341	---	---	TOTAL
MEAN	---	---	---	0.667	0.439	1.08	0.448	0.192	3.95	1.20	---	---	MEAN
MAX	---	---	---	1.85	1.48	2.30	2.08	0.316	40.8	4.47	---	---	MAX
MIN	---	---	---	0.148	0.117	0.430	0.220	0.092	0.094	0.326	---	---	MIN

SUMMARY FOR THE MONTHS APR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 1.13
MAXIMUM DAILY, 40.8A ON SEP 26

MAXIMUM INSTANTANEOUS,
45.1A AT 10:44 CST ON SEP 26

A - MANUAL GAUGE
B - ICE CONDITIONS

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	---	JUL 1	200
FEB	---	AUG	514
MAR	---	SEP 10	200
APR 1	730	OCT 3	230
MAY 1	180	NOV	---
JUN 2	790	DEC	---

TOTAL DISCHARGE, 20 800 DAM3

BATTLE CREEK BELOW NASHLYN PROJECT

STATION NO. 11AB101

MONTH	DAY	YEAR	TIME	DISCHARGES IN M3/S EVERY HOUR								TIME
SEP	21	1986	1-00	0.924	0.922	0.923	0.924	0.925	0.922	0.916	0.910	8-00
			9-00	0.909	0.909	0.909	0.909	0.911	0.912	0.913	0.913	16-00
			17-00	0.913	0.914	0.914	0.916	0.919	0.928	0.945	0.962	24-00
SEP	22	1986	1-00	0.983	1.010	1.030	1.050	1.060	1.060	1.070	1.070	8-00
			9-00	1.080	1.090	1.100	1.100	1.090	1.080	1.060	1.050	16-00
			17-00	1.030	1.020	1.000	0.990	0.976	0.961	0.946	0.932	24-00
SEP	23	1986	1-00	0.926	0.921	0.916	0.909	0.901	0.894	0.881	0.865	8-00
			9-00	0.849	0.833	0.817	0.801	0.785	0.775	0.766	0.757	16-00
			17-00	0.747	0.737	0.727	0.717	0.708	0.699	0.692	0.685	24-00
SEP	24	1986	1-00	0.678	0.668	0.657	0.648	0.642	0.636	0.630	0.626	8-00
			9-00	0.621	0.619	0.617	0.615	0.613	0.607	0.601	0.595	16-00
			17-00	0.591	0.587	0.584	0.587	0.628	0.677	0.698	0.729	24-00
SEP	25	1986	1-00	0.780	0.871	1.060	1.280	1.490	1.770	2.060	2.360	8-00
			9-00	2.800	3.450	3.990	4.800	5.240	5.770	7.230	10.100	16-00
			17-00	14.300	19.300	23.500	26.900	29.900	32.300	35.100	36.100	24-00
SEP	26	1986	1-00	37.700	38.600	40.200	41.100	42.100	42.800	43.800	44.400	8-00
			9-00	44.800	45.000	45.100	45.000	44.300	42.900	42.100	41.100	16-00
			17-00	40.100	39.100	38.200	37.500	36.600	35.700	35.100	34.600	24-00
SEP	27	1986	1-00	34.000	33.500	33.100	32.700	32.500	32.200	31.900	31.500	8-00
			9-00	31.200	30.800	30.300	29.800	29.300	28.800	28.000	-9999.999	16-00
			17-00	26.400	25.600	24.700	23.600	22.500	21.400	20.400	19.700	24-00
SEP	28	1986	1-00	18.900	18.200	17.500	16.900	16.300	15.700	15.300	14.900	8-00
			9-00	14.500	14.200	13.800	13.400	13.100	12.800	12.500	12.300	16-00
			17-00	12.000	11.800	11.600	11.400	11.200	11.000	10.800	10.600	24-00
SEP	29	1986	1-00	10.500	10.300	10.100	9.960	9.790	9.610	9.430	9.250	8-00
			9-00	9.060	8.890	8.720	8.550	8.390	8.230	8.090	7.970	16-00
			17-00	7.830	7.680	7.540	7.410	7.290	7.170	7.060	6.950	24-00
SEP	30	1986	1-00	6.840	6.740	6.630	6.530	6.420	6.320	6.220	6.150	8-00
			9-00	6.060	5.960	5.870	5.780	5.700	5.620	5.540	5.470	16-00
			17-00	5.390	5.330	5.260	5.200	5.140	5.080	5.020	4.970	24-00
OCT	1	1986	1-00	4.920	4.880	4.830	4.780	4.740	4.690	4.650	4.620	8-00
			9-00	4.580	4.540	4.500	4.460	4.430	4.390	4.350	4.310	16-00
			17-00	4.280	4.240	4.200	4.160	4.130	4.090	4.050	4.010	24-00
OCT	2	1986	1-00	3.970	3.940	3.900	3.860	3.820	3.790	3.750	3.720	8-00
			9-00	3.690	3.650	3.620	3.590	3.570	3.550	3.520	3.500	16-00
			17-00	3.480	3.460	3.450	3.430	3.410	3.390	3.370	3.350	24-00

BATTLE CREEK AT INTERNATIONAL BOUNDARY
(11AB027)

LOCATION: LAT.49-00-07 N., LONG.109-25-18 W., SE1/4 Sec.4 Twp.1 Rge. 26 W3rd.Mer. approximately 32 km south and 8 km east of Consul.

DRAINAGE AREA: 2580 km2

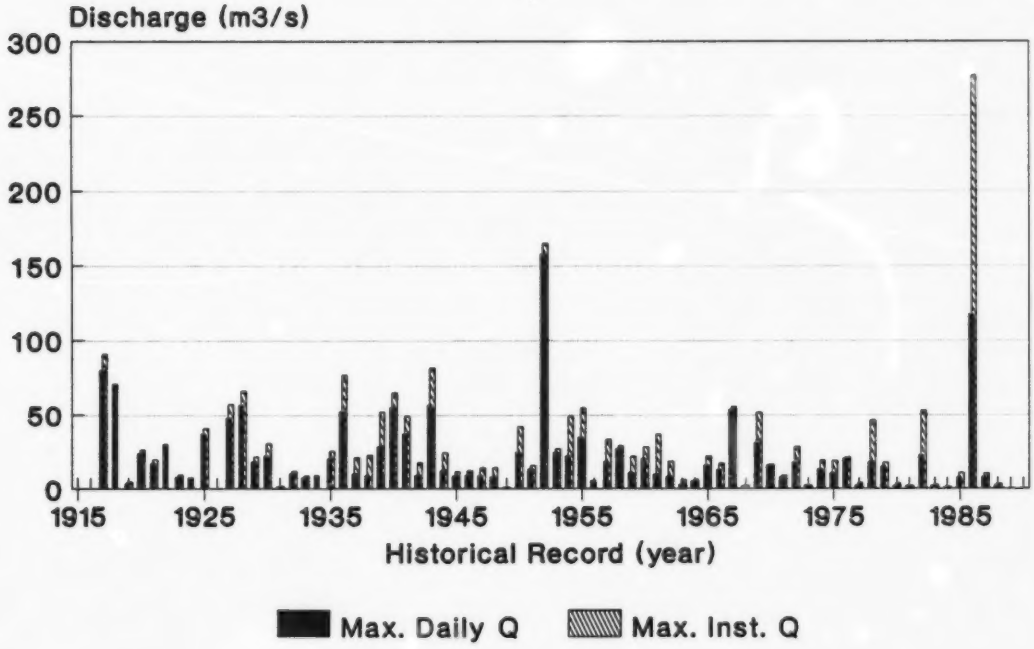
STAGE RECORD: Float activated recorder and data collection platform.

DISCHARGE RECORD: Trenton type concrete control with V-notch located 80 m below the station. Discharge measurements obtained by wading or cableway.

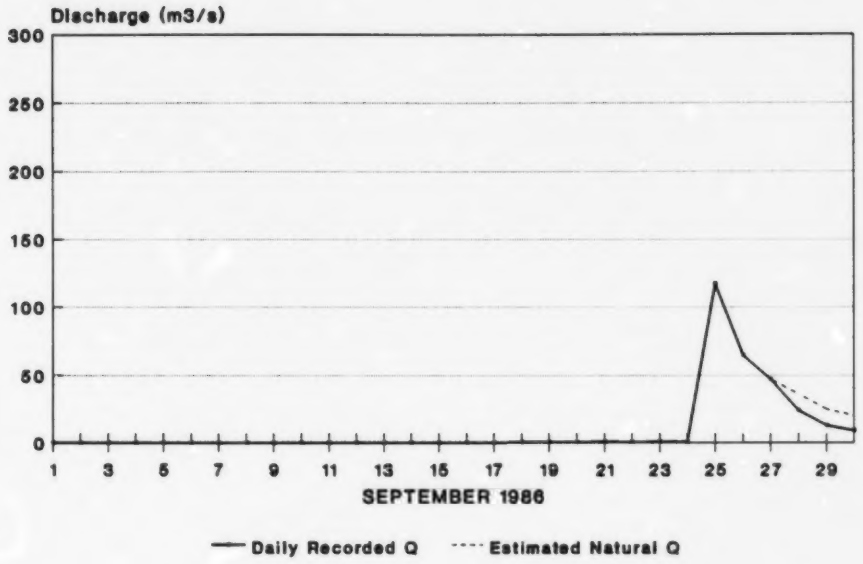
PERIOD OF RECORD: 1917 to present for open water seasons.

RECORDED MAXIMUMS: Maximum instantaneous recorded discharge is 277 m3/s (13:00 CST Sept.25,1986). The previous maximum was 165 m3/s (07:00 MST Apr. 15, 1952) . The maximum daily discharge is 158 m3/s (Apr. 15, 1952) with the next highest discharge of 117 m3/s occurring on Sept.25, 1986.

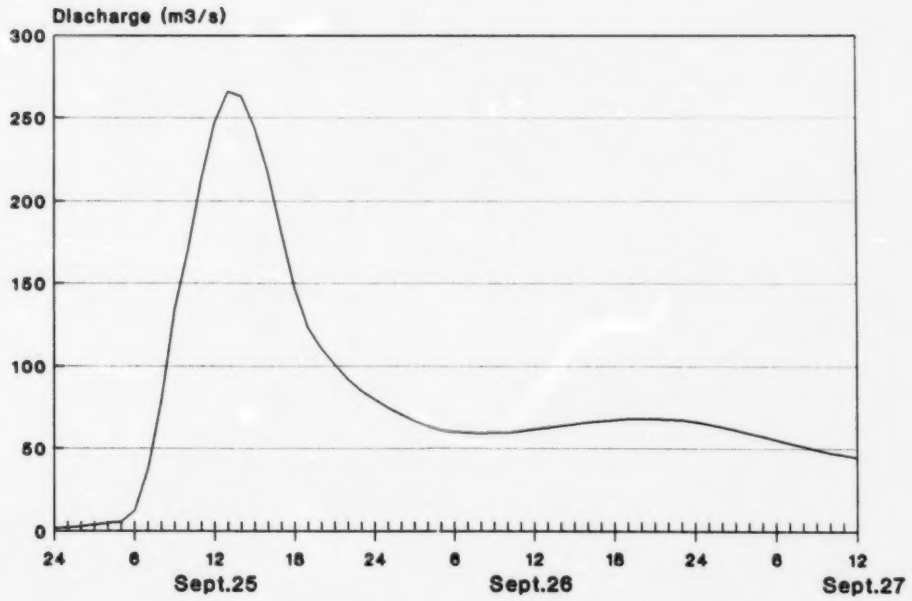
HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
Battle Creek at International Boundary
(11AB027)



HYDROGRAPH OF HOURLY DISCHARGE
Battle Creek at International Boundary
(11AB027)



NATURAL DAILY FLOW ESTIMATION

SEPTEMBER 1986

BATTLE CREEK AT INTERNATIONAL BOUNDARY

STATION 11AB027

Calculations for 11AB027 are similar to those for 11AB101 except that channel losses occur over one more day. The lag time from Adams Lake is 5 days so for storage accumulated on September 24 - 25 adjustments were made to recorded flows on September 29 - 30. For diverted flows at the Cypress Lake diversion canal area a 3 day lag period was estimated and flows were adjusted accordingly. Natural flows were estimated as;

$$\text{NATURAL } Q_{027} = \text{RECORDED } (Q_{027}) - \text{RECORDED } (Q_{077} + Q_{085} - \text{CH.LOSS}) + \text{RECORDED } (Q_{078} - \text{CH.LOSS}) + (Q_{ADAMS} - \text{CH.LOSS})$$

Where:

NATURAL Q_{027} = estimated natural discharge at Battle Creek at International Boundary
RECORDED Q_{027} = recorded discharge at Battle Creek at International Boundary
RECORDED Q_{077} = recorded discharge at Cypress Lake West Outflow Canal
RECORDED Q_{078} = recorded discharge at Cypress Lake West Inflow Canal
RECORDED Q_{085} = recorded discharge at Cypress Lake West Inflow Canal Drain

The natural flow estimation was only slightly larger (0.8 m^3/s) than the recorded daily flow. Indicating that storage occurring in Adams Lake had little effect on peak flows at station Battle Creek at International Boundary (11AB027), although some attenuation was noted on the hydrograph.

WATER SURVEY OF CANADA
OCT 01 1988 PAGE 8299
REGINA, SASK.

BATTLE CREEK AT INTERNATIONAL BOUNDARY

STATION NO. 11AB027

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	35.2 B	1.54	0.142	0.961	0.414	0.256	0.044	6.56	---	---	1
2	---	---	21.6 B	1.85	0.134	0.899	0.362	0.239	0.041	5.41	---	---	2
3	---	---	19.4 B	1.84	0.117	1.04	0.295	0.223	0.046	4.55	---	---	3
4	---	---	13.9 B	1.66	0.122	1.00	0.267	0.214	0.064	3.86	---	---	4
5	---	---	11.6 B	1.34	0.163	0.881	0.313	0.205	0.061	3.25	---	---	5
6	---	---	10.0 B	1.22	0.165	1.07	0.356	0.178	0.064	2.70	---	---	6
7	---	---	2.14 B	1.18	0.163	1.13	0.420	0.156	0.073	2.23	---	---	7
8	---	---	2.02 B	0.934	0.154	0.916	0.387	0.140	0.075	1.75	---	---	8
9	---	---	4.04 B	0.613	0.214	1.12	0.367	0.136	0.106	1.41	---	---	9
10	---	---	7.50 B	0.552	0.249	1.15	0.299	0.126	0.154	1.21	---	---	10
11	---	---	5.51 B	0.539	0.331	1.47	0.256	0.126	0.286	0.991	---	---	11
12	---	---	2.47 B	0.740	0.527	1.78	0.226	0.117	0.256	0.812	---	---	12
13	---	---	1.87 B	0.693	0.442	1.62	0.208	0.115	0.252	0.701	---	---	13
14	---	---	1.29 B	0.558	0.263	1.18	0.208	0.099	0.263	0.708	---	---	14
15	---	---	1.30 B	0.649	0.233	0.971	0.279	0.090	0.286	0.641	---	---	15
16	---	---	2.58 B	0.434	0.205	0.961	0.246	0.087	0.286	0.579	---	---	16
17	---	---	1.65 B	0.454	0.183	1.07	0.308	0.090	0.356	0.527	---	---	17
18	---	---	0.855	0.387	0.173	1.05	0.263	0.085	0.460	0.489	---	---	18
19	---	---	0.724	0.331	0.165	0.934	0.223	0.081	0.552	0.454	---	---	19
20	---	---	0.771	0.308	0.158	1.01	1.02	0.074	0.634	0.448	---	---	20
21	---	---	0.732	0.271	0.138	1.12	1.35	0.068	0.821	0.414	---	---	21
22	---	---	1.09	0.236	0.211	1.12	0.716	0.066	0.787	0.686	---	---	22
23	---	---	1.12	0.220	0.501	1.11	0.520	0.060	0.846	1.18	---	---	23
24	---	---	1.16	0.211	0.593	0.934	0.420	0.061	0.755	1.17	---	---	24
25	---	0.6908	1.37	0.197	1.87	0.641	0.318	0.064	117	1.16	---	---	25
26	---	2.23 B	1.53	0.191	1.67	0.454	0.271	0.063	64.9	1.17	---	---	26
27	---	8.67 B	1.49	0.186	1.53	0.420	0.208	0.058	46.8	1.15	---	---	27
28	---	11.1 B	1.56	0.170	1.24	0.382	0.178	0.054	24.0	1.14	---	---	28
29	---		1.92	0.156	0.864	0.414	0.160	0.054	12.9	1.12	---	---	29
30	---		1.87	0.147	0.812	0.466	0.290	0.046	8.87	1.09 A	---	---	30
31	---		1.74		0.829		0.295 E	0.048		1.04 E		---	31
TOTAL	---	---	162.002	20.007	14.561	29.274	11.443	3.479	282.038	50.600	---	---	TOTAL
MEAN	---	---	5.23	0.667	0.470	0.976	0.369	0.112	9.40	1.63	---	---	MEAN
MAX	---	---	35.2	1.85	1.87	1.78	1.35	0.256	117	6.56	---	---	MAX
MIN	---	---	0.724	0.147	0.117	0.382	0.160	0.046	0.041	0.414	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 2.34
MAXIMUM DAILY, 117 ON SEP 25
MINIMUM DAILY, 0.041 ON SEP 2
MAXIMUM INSTANTANEOUS,
277 AT 13:00 CST ON SEP 25

A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED

MONTHLY TOTAL DISCHARGE IN CUBIC DECAMETRES

JAN	---	JUL	989
FEB	---	AUG	301
MAR	14 000	SEP	24 400
APR	1 730	OCT	4 370
MAY	1 260	NOV	---
JUN	2 530	DEC	---

TOTAL DISCHARGE, 49 600 DAM3

B70

WATER SURVEY OF CANADA
MAR 16 1989 PAGE 3
REGINA, SASK. 13:55

BATTLE CREEK AT INTERNATIONAL BOUNDARY

STATION NO. 11AB027

GAUGE HEIGHTS IN THOUSANDTHS OF METRES AND DISCHARGES IN M3/S EVERY HOUR

MONTH	DAY	YEAR	TIME	GAUGE HT	DISCHARGE	GAUGE HT	DISCHARGE	GAUGE HT	DISCHARGE	GAUGE HT	DISCHARGE	TIME
SEP	24	1986	1-00	-9999	-9999.999	-9999	-9999.999	-9999	-9999.999	-9999	-9999.999	4-00
			5-00	-9999	-9999.999	-9999	-9999.999	-9999	-9999.999	-9999	-9999.999	8-00
			9-00	-9999	-9999.999	1147	1.600	1146	1.580	1145	1.560	12-00
			13-00	1143	1.540	1142	1.520	1141	1.500	1140	1.470	16-00
			17-00	1139	1.460	1138	1.440	1137	1.440	1138	1.450	20-00
			21-00	1144	1.560	1152	1.680	1156	1.760	1165	1.900	24-00
SEP	25	1986	1-00	1183	2.220	1218	2.810	1274	3.750	1346	4.990	4-00
			5-00	1390	5.730	1620	12.100	2072	37.600	2542	78.600	8-00
			9-00	2954	134.000	3145	170.000	3322	213.000	3436	247.000	12-00
			13-00	3497	266.000	3488	263.000	3429	244.000	3337	217.000	16-00
			17-00	3195	181.000	3034	147.000	2887	123.000	2797	111.000	20-00
			21-00	2730	101.000	2655	91.800	2600	85.000	2551	79.600	24-00
SEP	26	1986	1-00	2505	74.600	2465	70.600	2427	66.800	2393	63.500	4-00
			5-00	2367	61.200	2353	60.000	2348	59.500	2345	59.300	8-00
			9-00	2347	59.500	2351	59.800	2362	60.700	2373	61.800	12-00
			13-00	2385	62.900	2397	64.000	2408	65.000	2417	65.800	16-00
			17-00	2424	66.600	2432	67.400	2438	67.900	2441	68.200	20-00
			21-00	2440	68.100	2437	67.800	2432	67.300	2421	66.300	24-00
SEP	27	1986	1-00	2407	64.900	2389	63.200	2368	61.300	2346	59.300	4-00
			5-00	2324	57.400	2301	55.300	2278	53.400	2254	51.400	8-00
			9-00	2231	49.500	2208	47.600	2190	46.200	2172	44.900	12-00
			13-00	2156	43.700	2142	42.600	2129	41.700	2119	40.900	16-00
			17-00	2108	40.100	2098	39.300	2089	38.700	2080	38.200	20-00
			21-00	2072	37.600	2063	37.000	2053	36.300	2043	35.600	24-00
SEP	28	1986	1-00	2030	34.700	2016	33.700	2001	32.700	1985	31.600	4-00
			5-00	1968	30.600	1951	29.500	1934	28.400	1916	27.300	8-00
			9-00	1899	26.200	1882	25.200	1865	24.300	1849	23.300	12-00
			13-00	1833	22.400	1819	21.600	1805	20.800	1792	20.100	16-00
			17-00	1780	19.500	1768	18.900	1756	18.300	1747	17.800	20-00
			21-00	1737	17.400	1727	16.900	1720	16.500	1713	16.200	24-00
SEP	29	1986	1-00	1706	15.800	1700	15.500	1693	15.200	1686	14.900	4-00
			5-00	1680	14.600	1675	14.400	1669	14.200	1664	13.900	8-00
			9-00	1658	13.700	1653	13.500	1648	13.300	1642	13.000	12-00
			13-00	1637	12.800	1632	12.600	1627	12.400	1623	12.200	16-00
			17-00	1618	12.000	1614	11.800	1609	11.600	1605	11.400	20-00
			21-00	1600	11.200	1596	11.000	1591	10.900	1587	10.700	24-00
SEP	30	1986	1-00	1582	10.600	1578	10.400	1573	10.200	1569	10.100	4-00
			5-00	1565	9.940	1561	9.800	1557	9.650	1553	9.500	8-00
			9-00	1549	9.350	1545	9.210	1541	9.060	1536	8.910	12-00
			13-00	1532	8.770	1528	8.620	1525	8.490	1522	8.380	16-00
			17-00	1519	8.280	1516	8.180	1513	8.080	1510	7.980	20-00
			21-00	1508	7.870	1505	7.770	1502	7.670	1499	7.580	24-00

FREQUENCY ANALYSIS - WAKEBY DISTRIBUTION
11AB027 BATTLE CREEK AT U.S. BOUNDARY

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	32.658	41.409	1.268	3.924	23.200
LN X SERIES	2.933	1.141	0.389	-0.478	3.332

X(MIN)= 1.120
X(MAX)= 277.000
LOWER OUTLIER LIMIT OF X= 0.719

TOTAL SAMPLE SIZE= 64
NO. OF LOW OUTLIERS= 0
NO. OF ZERO FLOWS= 0

THE FOLLOWING WAKEBY PARAMETERS WERE OBTAINED BY ASSUMING M TO BE NON-ZERO. THE ITERATION ALGORITHM WAS NOT REQUIRED.

M= -0.374 A= 15.834 B= 1.88 C= 32.231 D= 0.413

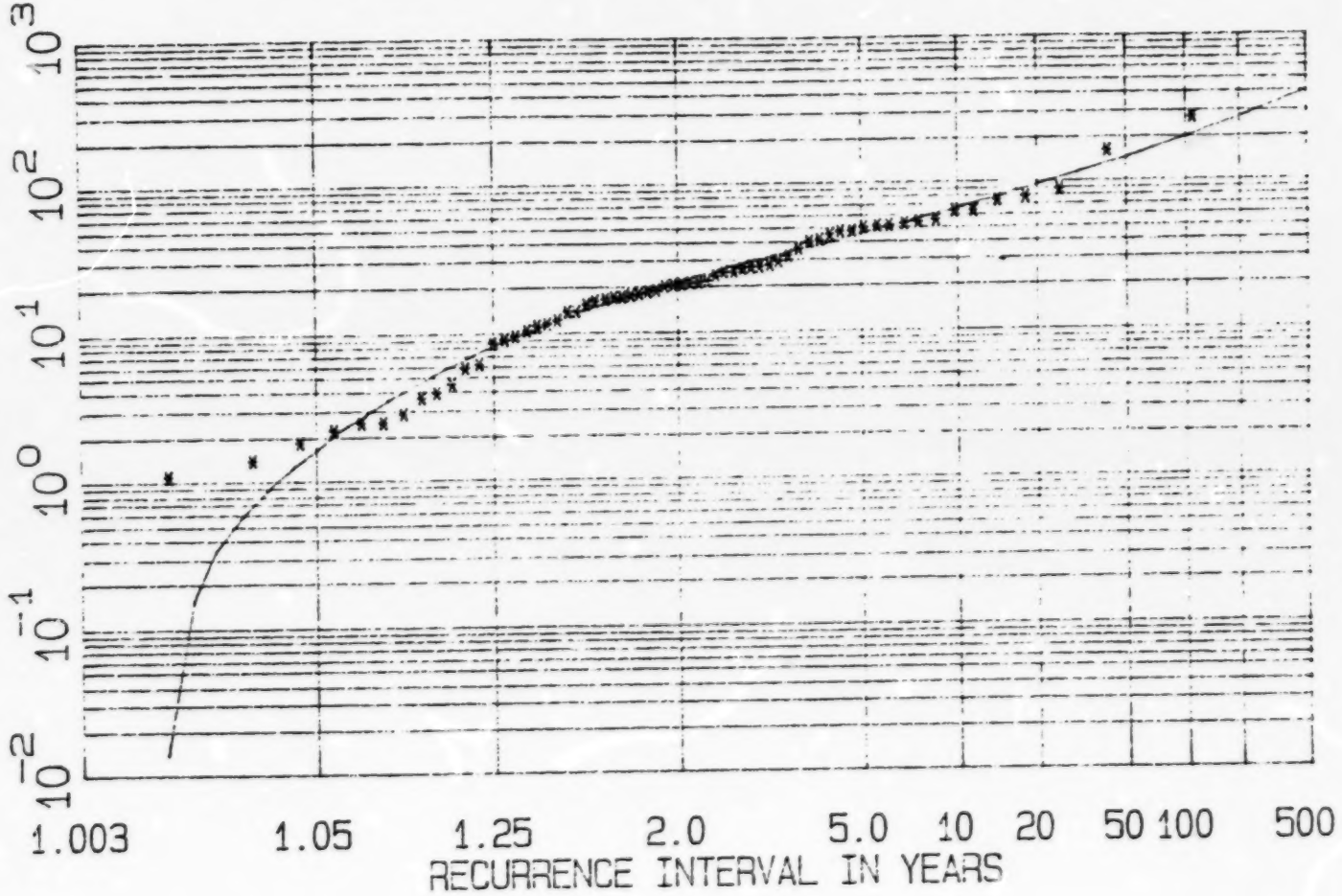
FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	0.997	-
1.050	0.952	1.67
1.250	0.800	8.17
2.000	0.500	21.90
5.000	0.200	45.10
10.000	0.100	66.50
20.000	0.050	94.30
50.000	0.020	145.00
100.000	0.010	199.00
200.000	0.005	271.00
500.000	0.002	403.00

11AB027

BATTLE CREEK AT U.S. BOUNDARY

FLOOD FREQUENCY - WAKEBY DISTRIBUTION



LYONS CREEK AT INTERNATIONAL BOUNDARY
(11AB075)

LOCATION: LAT. 49-00-17 N., LONG.109-13-18 W., SW1/4 Sec.1 Twp.1 Rge.25 W3rd.Mer. approximately 12.8 km south and 3.2 km east of Arena, Sask.

DRAINAGE AREA: 174 km2

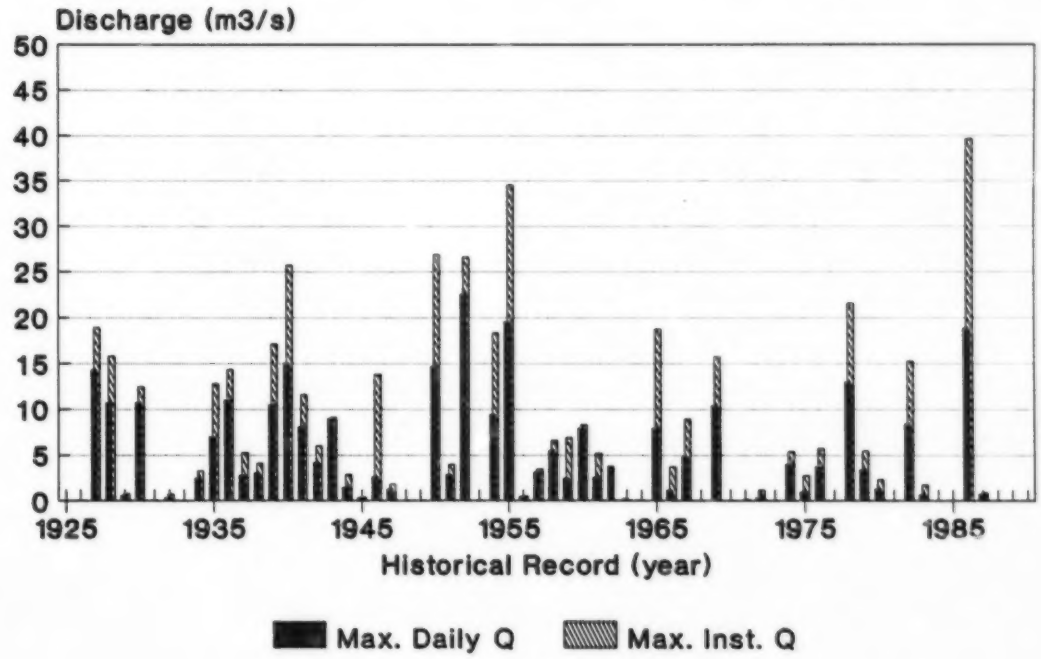
STAGE RECORD: Float activated recorder in standard shelter.

DISCHARGE RECORD: Stage-discharge relationship determined by wading or cableway measurements.

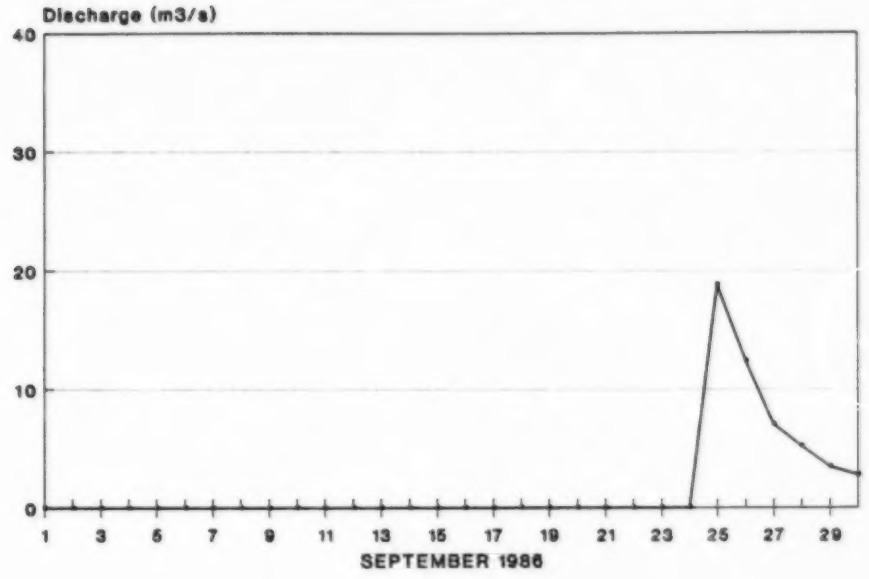
PERIOD OF RECORD: 1927 to date for open water seasons.

RECORDED MAXIMUMS: The maximum recorded instananeous discharge is 39.6 m3/s (13:00 CST Sept. 25, 1986) with the next highest flow of 34.5 m3/s occurring July 6, 1955. The maximum daily flows recorded are 22.5 m3/s (Apr.7, 1952) and 18.8 m3/s (Sept.25, 1986).

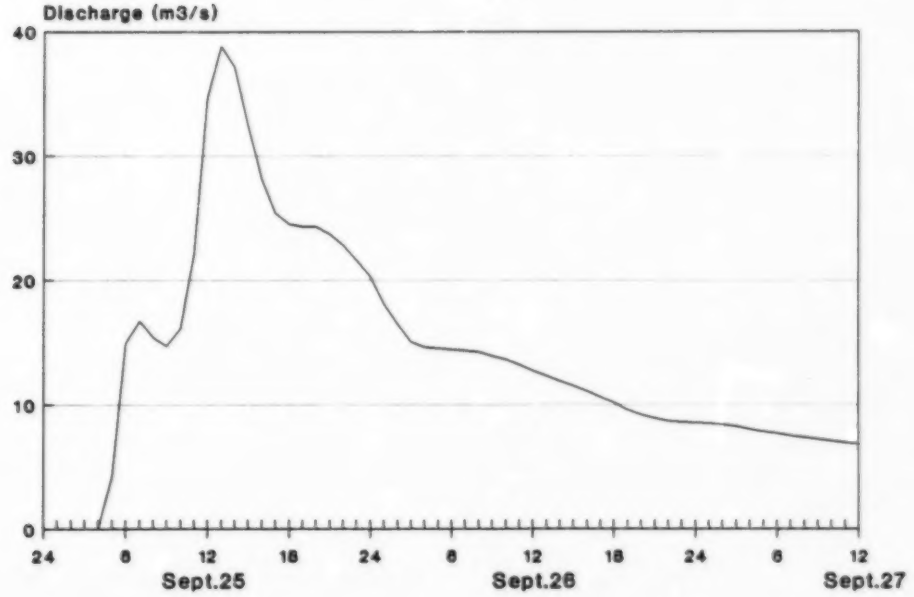
HISTORICAL MAXIMUMS
DAILY & INSTANTANEOUS



HYDROGRAPH OF DAILY DISCHARGE
Lyons Creek at International Boundary
(11AB075)



HYDROGRAPH OF HOURLY DISCHARGE
Lyons Creek at International Boundary
(11AB075)



WATER SURVEY OF CANADA
OCT 01 1988 PAGE 8649
REGINA, SASK.

LYONS CREEK AT INTERNATIONAL BOUNDARY

STATION NO. 11AB075

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1986

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	---	---	1.58	0	0	0.010	0	0	0	2.11	---	---	1
2	---	---	1.95	0	0	0.002	0	0	0	1.69	---	---	2
3	---	---	1.38	0	0	0	0	0	0	1.45	---	---	3
4	---	---	1.84	0	0	0	0	0	0	1.28	---	---	4
5	---	---	2.48	0	0	0	0	0	0	1.03	---	---	5
6	---	---	2.06	0	0	0	0	0	0	0.676	---	---	6
7	---	---	2.18	0	0	0	0	0	0	0.343	---	---	7
8	---	---	3.15	0	0	0	0	0	0	0.200	---	---	8
9	---	---	3.72	0	0	0	0	0	0	0.137	---	---	9
10	---	---	5.07	0	0	0	0	0	0	0.093	---	---	10
11	---	---	4.67	0	0	0	0	0	0	0.072	---	---	11
12	---	---	3.46	0	0.491	0	0	0	0	0.055	---	---	12
13	---	---	3.17	0	0.146	0	0	0	0	0.044	---	---	13
14	---	---	2.36	0	0.080	0	0	0	0	0.032	---	---	14
15	---	---	1.86	0	0.061	0	0	0	0	0.027	---	---	15
16	---	---	1.47	0	0.039	0	0	0	0	0.024	---	---	16
17	---	---	1.04	0	0.028	0	0	0	0	0.020	---	---	17
18	---	---	0.520	0	0.028	0	0	0	0	0.017	---	---	18
19	---	---	0.280	0	0.018	0	0	0	0	0.015	---	---	19
20	---	---	0.189	0	0.010	0	0	0	0	0.013	---	---	20
21	---	---	0.181	0	0.007	0	0	0	0	0.012	---	---	21
22	---	---	0.109	0	0.990	0	0	0	0	0.009	---	---	22
23	---	---	0.063	0	1.08	0	0	0	0	0.008	---	---	23
24	---	---	0.034	0	0.771	0	0	0	0	0.007	---	---	24
25	---	0 B	0.020	0	0.365	0	0	0	18.8	0.006	---	---	25
26	---	0.0208	0.011	0	0.196	0	0	0	12.4	0.006	---	---	26
27	---	0.3888	0.006	0	0.112	0	0	0	7.04	0.006	---	---	27
28	---	0.4328	0.001	0	0.069	0	0	0	5.18	0.005	---	---	28
29	---		0	0	0.044	0	0	0	3.46	0.004	---	---	29
30	---		0	0	0.026	0	0	0	2.77	0.004A	---	---	30
31	---		0		0.018		0	0		0.004E		---	31
TOTAL	---	---	44.854	0	4.579	0.012	0	0	49.65	9.399	---	---	TOTAL
MEAN	---	---	1.45	0	0.148	0	0	0	1.66	0.303	---	---	MEAN
MAX	---	---	5.07	0	1.08	0.010	0	0	18.8	2.11	---	---	MAX
MIN	---	---	0	0	0	0	0	0	0	0.004	---	---	MIN

SUMMARY FOR THE MONTHS MAR TO OCT

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 0.443
MAXIMUM DAILY, 18.8 ON SEP 25
MINIMUM DAILY, 0 ON MAR 29
MAXIMUM INSTANTANEOUS,
39.6 AT 13:00 CST ON SEP 25

A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	---	JUL	0
FEB	---	AUG	0
MAR	3 880	SEP	4 290
APR	0	OCT	812
MAY	396	NOV	---
JUN	1.04	DEC	---

TOTAL DISCHARGE, 9 380 DAM3

J 3

B76

LYONS CREEK AT INTERNATIONAL BOUNDARY

STATION NO. 11AB075

GAUGE HEIGHTS IN THOUSANDTHS OF METRES AND DISCHARGES IN M3/S EVERY HOUR

MONTH	DAY	YEAR	TIME	GAUGE HT	DISCHARGE	GAUGE HT	DISCHARGE	GAUGE HT	DISCHARGE	GAUGE HT	DISCHARGE	TIME
SEP	25	1986	1-00	168	0.000	168	0.000	168	0.000	168	0.000	4-00
			5-00	1062	4.160	1493	14.900	1542	16.700	1509	15.400	8-00
			9-00	1487	14.700	1528	16.100	1680	22.100	1954	34.700	12-00
			13-00	2031	38.800	2002	37.200	1909	32.500	1818	28.100	16-00
			17-00	1756	25.400	1736	24.500	1732	24.300	1731	24.300	20-00
			21-00	1717	23.700	1697	22.800	1668	21.600	1635	20.300	24-00
SEP	26	1986	1-00	1581	18.100	1534	16.400	1496	15.000	1483	14.600	4-00
			5-00	1480	14.500	1477	14.400	1475	14.300	1472	14.200	8-00
			9-00	1464	13.900	1453	13.600	1440	13.200	1427	12.700	12-00
			13-00	1413	12.300	1399	11.900	1385	11.500	1369	11.100	16-00
			17-00	1353	10.600	1337	10.200	1316	9.590	1303	9.230	20-00
			21-00	1291	8.920	1282	8.690	1278	8.590	1276	8.550	24-00
SEP	27	1986	1-00	1274	8.500	1270	8.400	1264	8.260	1257	8.060	4-00
			5-00	1249	7.880	1242	7.710	1235	7.540	1229	7.390	8-00
			9-00	1223	7.250	1217	7.100	1212	6.960	1208	6.870	12-00
			13-00	1204	6.790	1201	6.710	1198	6.630	1193	6.550	16-00
			17-00	1189	6.470	1185	6.390	1181	6.320	1178	6.260	20-00
			21-00	1175	6.210	1172	6.150	1169	6.080	1166	6.020	24-00
SEP	28	1986	1-00	1163	5.960	1159	5.890	1156	5.830	1153	5.770	4-00
			5-00	1150	5.720	1147	5.660	1144	5.600	1141	5.550	8-00
			9-00	1138	5.490	1135	5.430	1132	5.370	1128	5.290	12-00
			13-00	1124	5.220	1120	5.130	1114	5.020	1108	4.910	16-00
			17-00	1103	4.800	1097	4.700	1092	4.620	1086	4.530	20-00
			21-00	1081	4.450	1075	4.360	1070	4.280	1064	4.190	24-00
SEP	29	1986	1-00	1060	4.120	1051	3.990	1045	3.890	1041	3.830	4-00
			5-00	1038	3.780	1035	3.730	1030	3.660	1026	3.590	8-00
			9-00	1022	3.520	1018	3.460	1015	3.410	1012	3.360	12-00
			13-00	1010	3.340	1010	3.330	1009	3.310	1006	3.270	16-00
			17-00	1003	3.230	1001	3.200	999	3.170	997	3.140	20-00
			21-00	995	3.110	993	3.080	991	3.060	990	3.040	24-00
SEP	30	1986	1-00	988	3.020	987	2.990	984	2.970	982	2.940	4-00
			5-00	980	2.910	978	2.890	976	2.860	974	2.840	8-00
			9-00	973	2.820	971	2.800	969	2.780	968	2.760	12-00
			13-00	966	2.750	965	2.730	963	2.700	960	2.680	16-00
			17-00	958	2.650	956	2.620	953	2.590	951	2.560	20-00
			21-00	948	2.530	946	2.500	943	2.470	941	2.450	24-00
OCT	1	1986	1-00	937	2.400	929	2.310	927	2.290	928	2.300	4-00
			5-00	926	2.280	923	2.250	920	2.220	917	2.190	8-00
			9-00	914	2.160	912	2.130	909	2.100	906	2.070	12-00
			13-00	904	2.050	902	2.030	899	2.000	897	1.980	16-00
			17-00	894	1.950	892	1.930	890	1.910	889	1.900	20-00
			21-00	887	1.880	885	1.860	883	1.850	881	1.830	24-00

FREQUENCY ANALYSIS - WAKEBY DISTRIBUTION
11AB075 LYONS CREEK AT THE U.S. BOUNDRY

SAMPLE STATISTICS

	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	9.713	9.560	0.984	1.269	4.471

ZERO FLOW IN SERIES - LN X SERIES CANNOT BE COMPUTED

X(MIN)= 0.000
X(MAX)= 39.600
LOWER OUTLIER LIMIT OF X= 0.198

TOTAL SAMPLE SIZE= 48
NO. OF LOW OUTLIERS= 1
NO. OF ZERO FLOWS= 3

AFTER REMOVAL OF ZEROES AND/OR LOW OUTLIERS

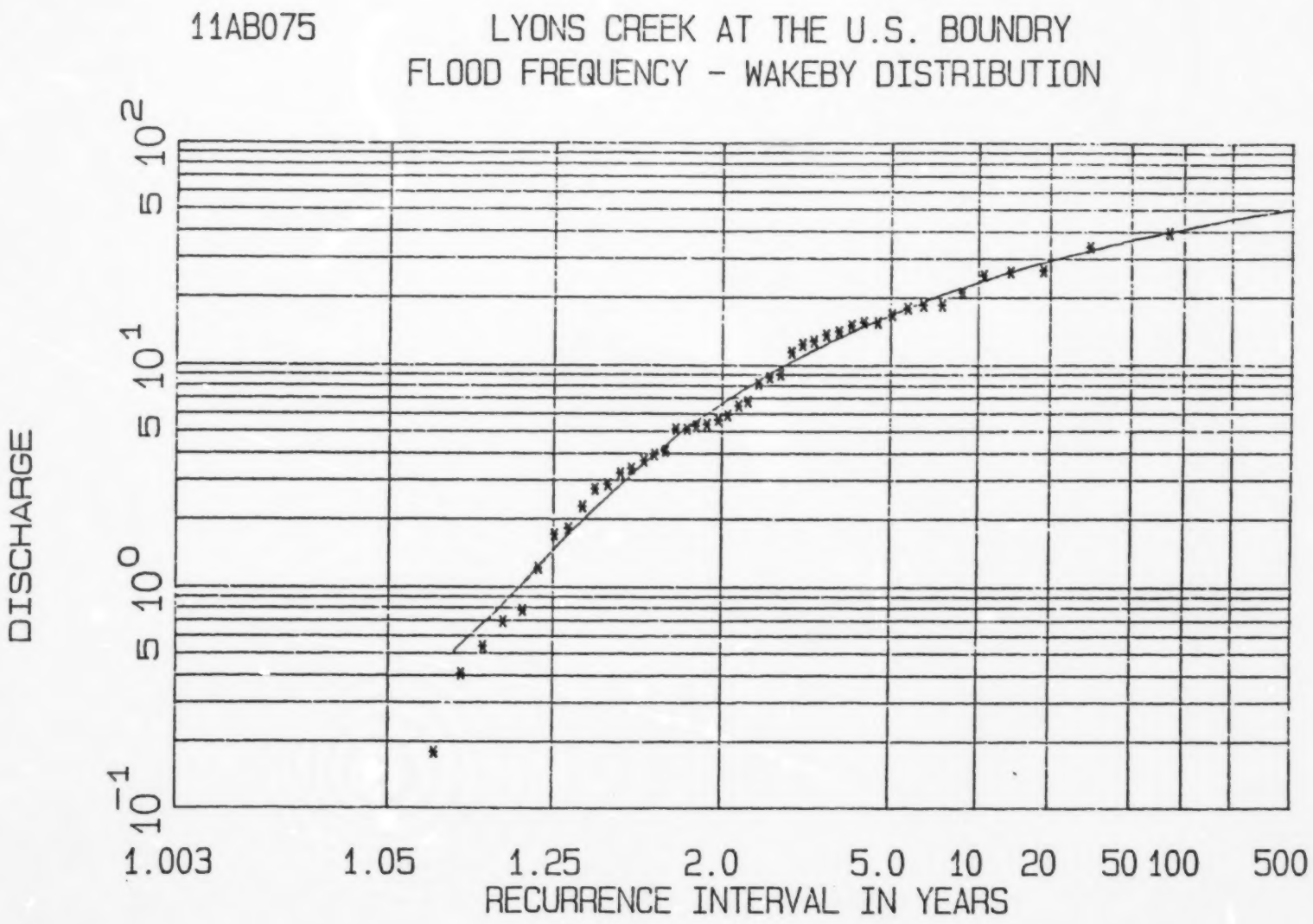
	MEAN	S.D.	C.V.	C.S.	C.K.
X SERIES	10.592	9.508	0.898	1.226	4.383
LN X SERIES	1.865	1.142	0.612	-0.636	3.054

THE FOLLOWING WAKEBY PARAMETERS WERE OBTAINED BY ASSUMING M TO BE NON-ZERO. THE ITERATION ALGORITHM WAS NOT REQUIRED.

M= 0.486 A= -1.356 B= 6.39 C= -82.444 D=-0.158
DISTRIBUTION IS UPPER BOUNDED AT E= 0.8157E+02

FLOOD FREQUENCY REGIME

RETURN PERIOD	EXCEEDANCE PROBABILITY	FLOOD
1.003	0.997	-
1.050	0.952	-
1.250	0.800	1.46
2.000	0.500	6.71
5.000	0.200	16.80
10.000	0.100	23.50
20.000	0.050	29.60
50.000	0.020	36.60
100.000	0.010	41.30
200.000	0.005	45.50
500.000	0.002	50.40


11AB075
LYONS CREEK AT THE U.S. BOUNDRY
FLOOD FREQUENCY - WAKEBY DISTRIBUTION
DISCHARGE
5 10^2
5 10^1
5 10^0
10^-1
1.003
1.05
1.25
2.0
5.0
10
20
50
100
500
RECURRENCE INTERVAL IN YEARS